TWENTY-SECOND YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

Vol. VII. (THIRD SERIES)
No. CXXXVI.

APRIL
1885

CONTENTS.

PAGE

ARTICLES.

1. Comet Systems. By J. R. SUTTON 185
2. Origin of the Idea of the Beautiful. By D. Y. CLIFF .. 193
3. The Bolivian Monster: Testimony in Science 195
4. The Colouring-matters of Flowers and Fruits 201
5. A Contribution to the Question of the Immortality of the Protozoa.. 204
6. Acclimatisation. By J. W. SLATER 205
7. A New Cosmogony.. 212

PAGE

ARTICLES—*continued.*

8. The Relations between the Station of Plants and the Structure of their Organs .. 219

ANALYSES OF BOOKS.

The Story of a Great Delusion in a Series of Matter-of-fact Chapters 222
High-Pressure Education 225
Nineteenth Report of the Board of Visitors to the (Melbourne) Observatory, &c. 226
Elementary Text-Book of Zoology 227
Practical Physics 229
&c., &c.

CORRESPONDENCE. NOTES.

LONDON:

3, HORSE-SHOE COURT, LUDGATE HILL.

Where Communications for the Editor and Books for Review may be addressed.

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THE

JOURNAL OF SCIENCE.

APRIL, 1885.

I. COMET SYSTEMS.

By J. R. Sutton.

"WHEN," says Guillemin, in his magnificent work 'The World of Comets,' "in accordance with the facts of Science, we endeavour to form an idea of the constitution of the visible universe, we see that the celestial bodies which compose this whole are everywhere distributed into groups and associations united by the common bond of universal gravitation.

"There are the *planetary systems*. In the centre of each group is a star or central sun whose preponderating mass retains near him, circulating in regular orbits, other stars or planets, to which the central sun distributes heat and light. Our planetary system is the type of associations of this kind.

"There are the *stellar systems:* groups of two, three, or more suns gravitating about one another, probably in accordance with the same laws.

"In certain regions of the heavens the nebulæ are themselves to all appearance grouped into systems, so that the general plan of the universe is one vast synthesis of associations of different orders encompassing each other without end. Nor can any individual star escape the necessity of forming a part of one of these groups.

"Are these likewise *systems of comets?*"

In answer to this query M. Guillemin gives a *resumé* of the results which followed upon the labours of Hock, a

Dutch astronomer of repute. These results seem to indicate that many comets do travel in systems, even as do the tiny meteors which circulate in common orbits around the Sun. The following table exhibits a specimen of one of these systems, showing the relative distances, at different times, with respect to the Sun, of the comets which compose it. This, also, I quote from the above-mentioned work.

Distances from the Sun in Radii of the Earth's Orbit.

Date.	Comet 1860, III.	1863, I.	1863, VI.
757·0	600	600·4	600·2
1020·9	500	500·6	500·4
1259·6	400	400·7	400·5
1470·0	300	300·9	300·8
1647·8	200	201·1	201·2
1785·1	100	101·8	102·1
1833·7	50	52·8	53·3
1853·6	20	24·4	25·5
1858·0	10	15·9	17·4

By this table it will be seen that whilst the three comets whose positions are here shown were in 1858 situated respectively at a distance of 10, 15·9, and 17·4 radii of the Earth's orbit from the Sun, they were in the year 757—or 1100 years ago—at very nearly equal distances from the ruling centre of the Solar System. Moreover, their paths are directed towards an identical portion of the celestial sphere, and, besides, their orbits differ but little from each other, being appreciably parabolic.

Now these facts are sufficiently surprising: they seem to show beyond doubt that these three comets are related and of common origin. Furthermore, the same remark will apply to several other cases, including not only the transitory visitors (as these may be) from interstellar space, but also several others which belong to the Sun's family.

But it appears to me that the conclusions founded upon the labours of the Dutch astronomer are somewhat far-fetched. Thus, we are told, almost it would seem as though the fact depended upon comets moving in systems, that "every star is associated with a cometary system *of its own*" (the italics are mine); "but owing to the attraction of planetary or other matter these bodies continually leave their proper primaries, and revolve either permanently in

ellipses, or temporarily in parabolas or hyperbolas, round other suns."

Why, now, should this conclusion be a resultant from the fact that some comets appear to be associated? Surely it does not follow with more certainty that because *three* comets are travelling in company from the region near any one star, that they emanate from that star, any more than it would follow that a single, solitary comet belonged originally to the domain of any star because it happened to be travelling away from it. Far be it from me to cast a slur upon the useful work which M. Hock has accomplished; but, so far as is given me to judge, it is quite certain that he leaves the question of the *origin* of comets, from whence they come and whither they go, very much as it was found. And, further than this, the table given above shows that somewhere near the year 750 the three comets we are discussing were at their nearest to each other; for if their motions be calculated backwards *beyond* 750 indefinitely, it will be found that all three are placed further and further apart the earlier the date to which we push our calculations. Thus the comet III., 1860, which was in that year less than half the distance of either of the other two from the Sun, would, if our inquiry be carried backwards sufficiently beyond 750, be found at a distance greatly in excess of the others, in consequence of its much more rapid rate of motion. The three, therefore, could never have started simultaneously upon their journey, as M. Guillemin seems to suppose, unless as a single comet; and in this case it is clearly discernible that not any more significance attaches itself to their movements than to the movements of a comet which retains its entirety. Nor is it conceivable that any star could so launch forth into space three separate bodies, at different times, that their common direction of motion should point towards the Sun. Still more impossible of conception is it that their separate velocities should be so adroitly imparted that all three were caused to join company at one time (some thousands of years after the commencement of their journey, probably), and in one spot.

Does it not seem more likely, then, that all three are the remains of a shattered comet? We know that comets have broken up almost under the very eyes of astronomers, and there is every reason to suppose that a similar catastrophe has happened in this case. Ephorus, the Greek historian, mentions that the comet of 371 B.C. divided into two; Kepler likewise speaks of the possible duplication of a comet which he observed, and got well ridiculed for his pains!

But in our own time a phenomenon precisely similar has occurred, the circumstances of which are briefly as follow:—On February 27th, 1826, a comet was discovered by Biela at Johannisberg, and was afterwards found to travel in an orbit of $6\frac{3}{4}$ years' duration. Since then it has, with only one exception, been observed at every approach to the Sun, up to the year 1846, in which year it split up into two distinct parts. Both of these receded from each other until the middle of February, when they were separated by an interval of 190,000 miles. After this time they approached somewhat, so that when they reached the limits of our scrutiny the distance between them barely exceeded 170,000 miles or thereabouts. In 1852 (their last observed appearance), however, they were found to have travelled asunder considerably during their period of invisibility, the distance having increased to 1,500,000 miles. And in short they may now, if still existing, be regarded as totally distinct bodies.

Now if phenomena such as this are possible, is it not also possible that the three comets mentioned above were generated similarly? For what is to prevent Biela's comet, or any other, from dividing yet again? In fact, for all we know to the contrary, a comet may carry on the process of duplication until, for want of bulk, a further division is no longer possible. Analogy would lead us to infer, if such is the case, that this triple system of Hock started into existence, as a system, in or near the year 750, at a distance of—in round numbers—57,000,000,000 miles from the Sun. Hence if this explanation be admitted—and it is obviously more probable than the other—it is clear that the mere fact of the existence of a system of comets teaches us nothing respecting the *birthplace* of these "vagabonds" of interstellar space.

Another point needs to be noted. The three comets referred to are travelling, as I have said, in orbits appreciably parabolic. Now nothing but a combination of most favourable circumstances would enable a comet to describe a strictly parabolic orbit round any star. For let us suppose it to be travelling alone with any velocity before it arrived under the influence of any foreign sun. Then this velocity it would never lose, unless by accident; and the velocity imported by its ruler for the time being would be additional, and, after a time, terminable. For no sun can command a velocity greater than it can generate: thus, since the comet would always retain its own native velocity in addition to that enforced by any extraneous power, the two velocities combined would supply the speed necessary to carry it back

to the space from whence it came. Hence in this case the orbit would be hyperbolic. A true parabola, however, requires such a nice adjustment that the least disturbance may transform it into an ellipse or hyperbola.

Now comets with hyperbolic orbits acknowledge neither permanent rule nor governance. They come down into our system with such a rush that the swiftly moving planets seem reduced to rest in comparison; but after their perihelion swoop they, in all cases, return to wander alone in space. Nevertheless it seems certain that comets are certainly captives from the realms of space. One theory, and one only, which regards comets as originating within the limits of the Solar System, is worthy of discussion,—the theory, namely, that comets are disgorged from the planetary volcanoes or erupted from the Sun. Yet even this when examined is found to be defective. For is it probable that Saturn or Jupiter could belch forth matter with a velocity sufficient to carry it in a retrograde direction round the Sun, after the respective manner of the comets of Temple (1866) and Halley? Surely not, since a velocity of projection of 35 miles a second would only just enable a comet to pass clear of Jupiter's attraction! Could the Sun, either, drive matter, such as comets are apparently made of, through his dense atmospheric envelope with a velocity sufficient to carry them for ever beyond his rule? In all possibility, when the depth and density of his elastic covering is taken into account, a velocity of 500 miles per second* would be insufficient! It is safer, then, to conclude that comets are entirely of extra-solar and extra-stellar origin.

But it may occur to the reader that we have just endeavoured to show that a comet advancing with a pre-received velocity into the Sun's domain could not remain as a permanent member of the Sun's family, *unless by accident.* This is just; and previous writers, who have held that comets are originally from without, have, in reply to this very question, formulated very elaborate hypotheses about comets being held in bondage by the Sun in consequence of "the disarrangement of their orbits by planetary influence," and so forth. Now it seems to me that this last supposition also is too imaginary to stand its ground for a single instant. We must, I fancy, go back into the Ages, to a time when the Sun ranked as a nebulous star, if we wish to arrive at the epoch when the Sun's *cortège* of comets were captured and reduced to a fair amount of obedience.

* This velocity of projection has been observed; it does not follow, however, that the erupted matter was necessarily a comet.

Those of my readers who have read my article in the "Journal of Science" (vol. vii., pp. 33 to 44) will perceive upon what grounds I build up that which follows. The theory running through that article was to the effect that the various suns throughout the universe draw in the loose matter from the surrounding space to feed *in part* their decaying energies. And it must at least be acknowledged that that theory accounted accurately for the observed facts to which I applied it. Hence, since this matter would naturally congregate thickly near the Sun's surfaces, the younger ages of a star must of necessity be nebulous.

Now let us take an imaginary case from the early periods of the Sun's history. We will suppose that a comet is moving towards the Solar System with a velocity supplementary to that which it acquires from the Sun. Then, granting that the nebular or meteoric matter is congregated with sufficient density in the Sun's neighbourhood, the comet will experience a certain amount of retardation in making its perihelion swoop. If, therefore, the retardation thus caused is sufficient to change its orbit from a hyperbola into a closed curve, be it ever so elongated, then will the comet be for ever under the Sun's dominion. With every approach to the Sun the same difficulty will be experienced in making the perihelion passage—though in a less degree each time, because if the orbit takes a great time to describe the Sun will have consumed a considerable quantity of his meteoric supply in the interim—until orbits such as those of the comets of Encke, Faye, &c., are attained.

Speaking incidentally of these last I am reminded that the periodical time of revolution of the former (the nearest of the known comets to the Sun) is constantly diminishing; only, it is true, by a matter of two hours or so on the average of each revolution, yet even this small decrease is sufficient to materially alter the comet's orbit in the course of time. Astronomers have thence concluded that some resisting medium retards the comet's movements, thus giving the Sun greater power to draw it towards himself; and this is probably the correct explanation. Can it be, then, that the meteoric matter which originally caused its capture from the outer space still aggregates near its perihelion? If so, it is pretty clear that it must be of less density than formerly. At any rate it is quite certain that meteoric matter does still exist in vast quantities in the Sun's immediate vicinity.

I have mentioned that comet systems exist both within the Sun's domain and outside. The last of these were, it

seems, formed after the manner detailed above; but the former, although they may have been in some cases formed similarly, must obviously have been formed after a somewhat different manner.

Let us inquire into this:—

The orbit of Jupiter is found to be exceedingly rich in cometic aphelions. So thickly, indeed, do they congregate that not in the instance of any other planet in the Solar System is the peculiarity so marked. Now the eruption theory claims that this circumstance is thoroughly confirmatory of the fact that the Jovian comet system had its genesis in the interior of Jupiter's mass. On the other hand, the advocates of the capture theory maintain that the facts prove that comets are captured from space, and brought under the Sun's attraction in consequence of the disturbing action of the larger planets; and certainly of the two the latter seems the more probable, albeit arguments have been recently adduced which entirely weaken its credit. But if comets are enlisted into the Solar System in the manner I have supposed, we can easily see that the mighty Jupiter would possess an influence over the new arrivals greater than that of all the other planets put together. Hence we should expect their aphelions to lie in the vicinity of Jupiter's orbit. And thus would arise the Solar Comet Systems, which could easily, as in the case of Biela's comet, increase the number of its component members by duplication.

Note.—It is necessary, perhaps, to explain more fully those passages in which reference is made to the earlier ages of Solar Systems. To put the matter shortly—How do we know that loose matter is drawn into a planetary system from outer space? In the first place, we can trace a process which is nothing if it is not a graduated series of world development. On every hand we have sure signs that evolution is not confined to animals and vegetables alone. And although we have never yet been able to observe the actual transformation of a nebula into a star system, we have, nevertheless, something which amounts to almost the same thing, when we remember that from the irregular nebulæ to the perfectly formed star, or star system, the gradation of world development is without a break. None of those "missing links" trouble the student of the star-depths as they trouble those enthusiasts who—without being either

students of Nature or philosopers—can yet assume (by virtue of their loud voices it would seem) to proclaim from the house-tops the wickedness and the degradation of Darwin and his disciples. And passing from thence to the Milky Way, we perceive there—in almost any spot to which our telescope happens to be pointed—the affinity which quite obviously exists between the large and small orbs which together make up that wonderful zone. Wherever a brilliant star exists, there either is the adjacent space cleared of small stars or these last are clustered in more than average numbers,—both of which circumstances prove an affinity, or else, if we like to close our minds to evidence, a most remarkable concourse of coincidences; at all events, a fact sufficiently formidable to prove that the distances separating the brighter from the less brilliant orbs is not so great as had previously been supposed. Now except in those branches which *must* here and there extend outwards away from the Earth—for we cannot logically suppose that all the branches from the main stream of the Galaxy are lateral, that is, that they all run in directions square to the visual ray from the Earth—the Milky Way cannot possibly have a greater average depth than it has average breadth. We may, in fact, fairly regard it as a belt. And because nothing leads us to conclude that the most powerful telescopes yet constructed have been powerful enough to thoroughly analyse this belt (every increase of instrumental range showing a greater number of stars), we may safely infer that the number of stars made visible would go on increasing with every further such increase of range. These stars of lesser brilliancy must therefore be actually, as well as apparently, small; and indeed analogy points to the conclusion that there is not any limit to their smallness, for here, it does appear, have the bulk of the whole of the small bodies (those parents of the larger orbs) from the bounds of the visible universe been collected.

II. ORIGIN OF THE IDEA OF THE BEAUTIFUL.

By D. Y. Cliff.

I WAS particularly struck the other day with this thought as I stood gazing from the heights of Rumble's Moor up the rocky vale of the Wharfe:—Why was it "beautiful" to me? Why should my frame be thrilled and my thoughts elevated? No wonder the old Jews were led to build altars in "high places"! I have been down in the dark galleries of great coal-mines; I have walked street after street of working men's houses; I have gone through great factories, and watched uncouth monsters doing the work of hosts of men; but none of these were beautiful to me, or to any one else either.

It is not "being used to it." It is not because it has a pleasant or objectionable association,—that is, affection, prejudice, bigotry.

The face of one woman is sweet, another is repulsive, even though both are young; these are with us every day, so it is not "a matter of education."

Again, the Black Country, the Rochdale district, &c., have no charm for us; but the Royal Vale of Cheshire, or the woods and fields that line the "swift flowing" Wharfe, —the Bolton of Wordsworth,— these stay our gaze and arouse our better feelings. But they who live amongst these diverse scenes are neither better nor worse than other folks; the appreciation of the beautiful is then no individual life matter.

The explanation of all this is perhaps unromantic to some: there is no other solution to it than Evolution. It is inbred in our nature; it is of a piece with the instincts of birds, &c.; in fact it is a human instinct.

When we know that a healthy colour in the cheeks betokens vitality, vigour, health, strength, &c., and bear in mind that such would be the "fittest" who would "survive" their weaker sisters, is there any longer a doubt why the rosy cheek became beautiful in our eyes?

Such men as mated with weaklings in the old ages would leave no offspring fit to hold their own, so that the red cheek would force itself (certainly through no, or little, choice) into our sense of the beautiful. Those of our fathers who,

by caprice, fancy, or otherwise, preferred the healthy woman, naturally propagated their idea downwards. Certainly they did not know what they were doing, and doubtless we are doing a number of things just in the same that we don't know. This instance will apply to every part of the human body, every one of which no doubt has worked itself out from "the best," the fancy becoming an inbred and useful instinct. It stands to reason, then, a taste for a pale face is false, acquired; but no doubt it has a complex reason for it: if it had not, a pale face would be hideous to every eye.

What is hideousness? Merely the negative to our notion of the beautiful? Is it not the unusual, the unfamiliar? our perceptions are afraid of it. An ugly face: is it an unavoidable outcome? Or was it congenial to the general ideas of its parents? Perhaps not to the immediate ones; but, disagreeable though the question is, may it not be "in the race"? There is undoubtedly a reason and a law for all things. The beautiful does not infallibly indicate a similar mind,—often the reverse (though a man or woman's "notion of himself or herself" must leave its impression in their posterity). There must be great complexity; to add a new influence (in the shape of a fresh "cross") is like pouring a new element, not only into one pot, but a host of pots alongside one another, all containing different compounds,—and that new element is itself a compound. The old parts are still *there*, but how different and unrecognisable!

The beautiful is the everlasting, familiar, and useful; whilst the hideous is that which has been rare in the long work of Evolution, and hence, avoided and scorned, the development of the taste for the "local type of beauty" is quite recent to this.

The beautiful in thought is a repetition of that in existence; our brain has become used to its passages. Directly we wander into the regions of pure thought it ceases to be beautiful, and becomes "dry." (The distinction between sensuous thought and thought-thought—so to speak—is a profound subject yet to be solved).

So when I look on the mountains, and love them, it is because they filled the brains of my fathers for æons of ages; and when I peer about the dark caverns that man has excavated, they have no beauty to me, because my fathers knew them not.

Query,—Is one cause of the stunted race of mechanics due to the constant strain on their vitality owing to its

exertions in continually accustoming itself to those sights which are racially (so to speak) strange, as yet not ingrafted as "instinct"? (How much power over the health has the mind?)

The artist prefers a ship in sails to the more modern steamboat,—why? Because his fathers have been familiar with the one for generations, and the other is "new," and still has to be imprinted on the brain of man so as to leave its effect on his seed.

III. THE BOLIVIAN MONSTER: TESTIMONY IN SCIENCE.

FROM time to time the naturalist is exercised by rumours, more or less definite, of the occurrence—or even the capture—of some novel or anomalous animal. We do not here intend to speak of *the* sea-serpent, although against the positive evidence for its existence there can be set merely a fact of doubtful value,—*i. e.*, that no large snake-like vertebræ have ever, as far as is known, been washed ashore or dredged up from the depths of the sea. Far less attention has been paid in the outside world to the reports of a gigantic subterranean creature, said to occur in Brazil, and occasionally to displace and uproot trees in its burrowings.

Coming nearer our more immediate subject we may refer to an account which reached us some years ago of the capture, in the interior of Queensland, of a powerful and dangerous Saurian quite distinct from the crocodiles and alligators of modern times, and approaching more closely to certain extinct reptile groups. This animal, we learned, had killed and devoured several "black fellows," and had at last been destroyed after a desperate struggle. The skeleton, we were informed, was on its way to London. Unfortunately it has never arrived.

Now in all the cases just mentioned there is no antecedent improbability. The very name "sea-serpent" has become almost a synonym for a baseless falsehood. Yet since we

see that the ocean is the home of mammals, vastly transcending in size the largest terrestrial species, it is at least not impossible that the same rule may hold good for reptiles. The sea-serpent, according to the most liberal statements, only bears the same proportion to the python that the whale does to the elephant.

An earthworm of 6 feet in length has actually been captured in South Africa. A species not greatly superior in size may have been the cause of the probably exaggerated reports of the underground monster of Brazil.

Nor was there in the story of the Queensland saurian any feature which could *à priori* inspire suspicion. It is surely unsafe to say that all animal forms—even of large size—existing in the world have been already captured, described, dissected, and duly deposited for examination in our museums. Nor have we any warrant for at once denying the existence of a species of unusual dimensions. Still less are we justified in sneering at those who would bid us, in such cases, at least to suspend judgment until decisive evidence has been obtained.

There are, however, cases in which incredulity is much more warrantable. Thus some years ago we saw, in a literary and political organ of the *ulcerated* class, as "Punch" once termed them, a figure and description of a "sea-monster" said to have been observed somewhere on the western coast of South America. This creature, whether it had a real existence or whether it had been evolved out of the consciousness of "our own artist," presented the startling feature of three pairs of limbs. We need scarcely say that no vertebrate animal, recent or fossil, has been found possessing more than two pairs.

The Bolivian monster, which is our more immediate subject, displays a characteristic still more improbable. We do not say "impossible," since the use of this word in Science is rarely prudent, accused as *savants* now often are of their liability to the "credulity of scepticism." It may indeed be useful, before proceeding to a description of the animal in question, to justify the reluctance of scientific men to accept human testimony unsupported by evidence of a more palpable kind. This reluctance has, we believe, called forth of late some very strong comments. It has been pronounced singular that evidence such as in any Court of Law would suffice to convict any accused person of murder, should, in the Courts of Science, be dismissed as utterly inconclusive.

On careful reflection, however, an essential difference

cannot fail to strike every unprejudiced person : in the cases which come under the notice of Courts of Law,—such as murder, robbery, forgery, incendiarism, and the like,—the question is concerning matters which are, unfortunately, within the range of ordinary human experience. We know that under certain circumstances men have the power and the will to commit murder. Hence the Court has merely to deal with a very simple problem, which may be solved by the consistent testimony of two or more persons of sane mind and unblemished character, provided it appears that they had had the opportunity of observing what really took place.

But let us suppose that two witnesses, unexceptionable in every respect, came forward and swore that a certain person, A. B., being involved in a quarrel with C. D., stepped back and made a strange gesture, whereon the earth immediately opened and swallowed up C. D. : would A. B. be, upon such testimony, condemned to death as a murderer ? We believe the Court would hold that it must first be shown that any man has or can have the power of causing the earth to open when and where he pleases. In default of proof of this nature the sanity or good faith of the witnesses would be called into grave question, and it would be contended that the opening of the earth, if it actually took place, was a mere coincidence, for which the accused was in no way responsible.

The consideration of this supposed case, as contrasted with an ordinary murder with poison, with fire-arms, or with the dagger, will throw light upon the alleged reluctance of scientific men to accept human testimony. They show no reluctance when the phenomenon testified to comes within the scope of ordinary experience. When it does not fall within such scope they naturally demand other evidence. Thus, suppose a traveller, returning from Central Africa, informed the world that he had found a mass of a substance possessing all the chemical and physical attributes of iron, but of so low a specific gravity as to float upon ordinary water, his report would be rejected, and that by men of the world, perhaps, even more emphatically than by men of Science. There is certainly no *à priori* reason why the chemical properties and the physical attributes—save one—of iron might not occur in a substance as light as potassium. But the fact that no one, alike in laboratory or museum, in market or workshop, had met with such iron or iron-like substance, would ensure the rejection of the story except the traveller had brought with him a specimen of the strange

metal. Then our conceptions of what is "possible" would have to be re-adjusted.

Or suppose some chemist not known to fame should succeed in decomposing one of the so-called elements, and of transmuting one into another. Here, also, there is no *à priori* impossibility. He would merely have succeeded in doing what many have attempted and are attempting, and what probably all chemists desire to see done. But his report would be received with hesitation until his experiment had succeeded in other hands, or at least had been repeated by himself in the presence of competent judges.

Here, again, our views as to the extent of the possible would have to be enlarged. It might perhaps be well if we had another term to be used in place of "impossible" in all matters of contingent truth. In such cases we want a word to express what lies outside of, and is more or less signally opposed to, general experience. It will, we think, be admitted that the more widely any alleged fact departs from such general experience, the more complete verification it will require.

We may now turn to the account before us of the Bolivian monster. A brief notice of it was forwarded us by a Manchester correspondent,—a gentleman whose well-known intelligence and standing excluded all suspicion of a *canard* or of an intended hoax. His letter was published in our issue for June, 1883 (p. 368), and earned us in certain quarters a few sneers. We now learn further particulars from the "Journal de Luna" and from "Cosmos."

The animal in question was killed in the River Beni, in Bolivia—one of the tributaries of the Madera, and hence indirectly of the Amazons. A photograph was taken of the body, an engraving from which appears in "Cosmos." The skeleton is said to have been conveyed to the city of La Paz, where it is now deposited. The length of the animal, from the head to the extremity of the tail, is given as 12 metres, or, approximately, 40 feet. No other dimensions are given, but the body—judging from the figure before us—is exceedingly massive. The general aspect of the creature is that of an aquatic Saurian. There is the usual armour-clad trunk. There are four powerful legs, terminating in formidable claws, but so short that the belly will scarcely clear the ground. The tail is of the usual Saurian character, very much thicker than is met with in any mammal, but differing from that of the crocodiles by the absence of ridges, and by being compressed not laterally, but vertically towards the tip. But when we turn to the head our ideas of the

fitness of things receive a shock. Everyone must have observed that in lizards and crocodiles the neck (if we can admit that one exists at all in the familiar sense of the term) and the head lie in the same plane as the back. In this animal, on the contrary, we see a neck—proportionally as long as that, *e.g.*, of a greyhound—rising upwards nearly at right angles to the back, and supporting a head which presents, externally at least, most of the characters of a mammalian head. It is remarked, in the description accompanying the plate, that the head resembles that of a dog. There is a prominent forehead, such as we find in certain heads of dogs, quite unlike the flattened Saurian type of skull. Above all there are two upright external ears, not unlike those of the fox. The importance of this feature will appear if we reflect that no reptile now living, or as far as we know extinct, possesses an external ear; the only approach in that direction is a fold of skin at the auditory opening in the crocodile. Indeed a projecting external ear is so essentially a mammalian feature that an animal belonging to any other division of the vertebrates thus equipped has to the human mind an uncanny aspect.

The only non-mammalian character shown in the plate lies in the teeth and in the width of the gape. The teeth, as far as can be judged from the figure, offer no distinction of incisors, canines, and molars, but consist of a row of sharp wedges, differing little in size, and all pointing somewhat backwards. The articulation of the jaws is at a point much farther back than in mammals, so that the gape is very wide. The lower jaws form almost a flat plate, and no trace of a tongue is visible. If that organ, however, is formed on the crocodilian type, it will not be apparent on a side view of the head, even when the jaws are open. Still, notwithstanding these anomalous features, if the figure is covered up with paper so as to leave merely the head uncovered, non-specialists—in every trial which we have made—pronounce it to be the head of some ferocious mammal.

Whether there exists hair upon the face, or any part of the body, does not appear either from the figure or the description. We must, however, remember that the existence of hair in reptiles is not unheard of, since a small hairy tortoise has been discovered in China.

So far, therefore, this animal possesses characteristics sufficiently anomalous. What follows, if it does not fully justify complete scepticism as to the alleged nature and the very existence of this animal, makes us crave eagerly for fuller and clearer information. According both to the figure

and the description the creature has, in addition to the head already described, two others, placed in a parallel position on each side of the spine, about 12 or 13 feet behind the normal head. These two subsidiary heads, though somewhat smaller, have the same eyes, ears, and jaws as the principal head, and they are both turned forwards.

It is scarcely necessary to say that nothing similar has been observed either among the vertebrates, the arthropods, or any other cephalous class of animals.

We may venture on the assertion that these extra heads are either really existent, or they are a wanton and intentional falsehood. We cannot here conceive the possibility of a mistake or of exaggeration. Supposing for a moment we have here before us the record and the portraiture of an actual fact, we have next to ask—Is this a normal feature of some rare animal species, or have we to do with a monstrosity? Prof. Givelti—whose address unfortunately is not given, or we should have taken the liberty of communicating with him—has examined the animal, and forms the conclusion that the specimen is not a monstrosity, but is a perfectly normal member of a rare species. One circumstance upon which this conclusion is based is that certain earthen vessels, which date back to the time of the Incas, are made in imitation of the form of this animal. Hence it is inferred that in former times this strange Saurian was more common than at present, and by its singularity of form—certainly not by its beauty—attracted the notice of the ancient Peruvian potters.

We cannot here take up the numerous and grave questions, morphological, physiological, embryological, and taxonomic, which the existence of this creature, if verified, is certain to raise. It will be a moot point to decide whether its existence will be harder to account for on the theory of direct individual creation, or on that of development by natural selection: both, as it seems to us, will find the task far from easy.

We may, however, glance at the evidence for the actual existence of the creature before us. The two accounts we have received do not exactly tally. That taken from the Anglo-Brazilian "Times" of March 24th, 1883, says that the Brazilian representative at La Paz had sent home to his Government "photographs of drawings" of an extraordinary Saurian. On the other hand, the "Journal de Luna" says merely that the same official had sent "several photographs" of an extraordinary Saurian. This difference is very serious. If the photographs have been taken directly

from the animal they furnish conclusive evidence as to its external structure; but if the photographs have merely been taken from a drawing they may embody merely the invention or the exaggerations and distortions of the artist. We fear that the latter is the case, because the figure before us represents the animal standing on its feet, with its necks erect, and its eyes and jaws open as if ready for combat. We doubt strongly whether any explorer on the Beni would travel provided with the necessary appliances for the instantaneous photographic process. The writer in "Cosmos," who does not give his name, obtained his account from his brother, a missionary in Chili, who had translated it from the original Spanish of the "Journal de Luna." He promises, however, further information as soon as it is obtained.

IV. THE COLOURING-MATTERS OF FLOWERS AND FRUITS.

WHETHER we assert that the colouring principles of flowers and fruits have been evolved by a process of natural selection, or that they have been determined by a direct creative act, we give merely a final cause for their appearance, leaving the efficient cause or causes untouched. Yet to many minds it is assuredly the more interesting to know how, when, and where the various colouring-matters have been formed, and by what mechanism they have been transported to those particular parts of the plant where we find them, leaving its other parts untouched. We almost fear that the popular study of Natural Selection has withdrawn attention from these questions. Naturalists have come to think that if it can but be shown how the development of intense colour in the flower attracts insects and promotes cross-fertilisation, all is explained, and *presto!* the colour must make its appearance.

It is therefore satisfactory to find that Dr. A. Hansen has recently carried out some very important researches on the colouring-matter of flowers. His chief results have been

published in the "Verhandlungen der Physik. Med. Gesellschaft zu Würzburg" (vol. xviii.), and in the "Naturforscher."

It appears that a relatively small number of pigments serves for the production of the seemingly endless variety of colour in flowers and fruits. The white and black shades which we encounter there are not due to any especial colouring-matter. White is due merely to the reflection of light through colourless tissues containing air. Blacks owe their origin merely to the dense concentration of violet pigments. If we set aside chlorophyll green, which is rarely met with in flowers [but in fruits?], we may recognise the three following groups of colours:—1, yellows; 2, reds; and 3, blues and violets.

As was previously demonstrated by Hildebrand, the yellows are mostly in combination with the plasmic substance, whilst the colours of the second and third group are generally found existing in solution in the cell-sap.

The yellow of flowers forms an insoluble compound with fatty matters, as was demonstrated by Krukenberg in the animal kingdom under the name of lipochrome. [This circumstance may go far to account for the general comparative permanence of the yellow colours both of plants and animals.] The yellow pigment obtained by Hansen in a pure crystalline state, by saponification with soda and extraction with petroleum ether, agrees in its behaviour with the lipochromes. The spectra of the pigments of different yellow flowers agree with each other so closely as to lead to the conclusion of their mutual identity. Between the F and G lines there occur two absorption-bands, which do not, however, always occupy exactly the same position. The solutions are not fluorescent.

Orange is formed by a denser deposit of the yellow pigment. Thus the colour of the rind of an orange is due to the same pigment as is found in the yellow flowers of *Ranunculus repens*.

The colour of yellow dahlias and of lemon-rind is not a lipochrome. It is soluble in water, and behaves differently both chemically and spectroscopically, displaying, for instance, no absorption-bands. It is very similar to the pigment of *Æthalium septicum* examined by Krukenberg.

The reds of flowers may be reduced to a single pigment,—the rose-dye of roses, carnations, peonies, &c. It is soluble in water, and is decolourised by alcohol, probably in consequence of dehydration. On the addition of an acid the colour is restored. The spectrum displays a broad

absorption-band between D and F. The varying intensity of the colours of roses, carnations, and peonies depends probably on the presence of acids. The scarlets and brick-reds of poppies, scarlet lilies, the berries of the dog-rose, &c., are produced by the simultaneous presence of lipochrome.

The blue and violet pigments turn pale also in alcohol. The solution is reddened by the addition of an acid, as was noticed by Fremy and Marquardt. They assumed therefore that the red colours were merely blue pigments modified by acids. Hansen, on the other hand, holds that the blue and violet colours are derivatives of the red. In favour of this view is the fact that certain blue and violet flowers (Borragineæ) are at first red. [The flowers of *Erica cinerea* are on opening red, but turn more to a violet on fading. On the contrary, the corolla of many fuchsias passes from a bluish violet to a red.] Salts of iron turn the red of peony flowers to a violet. Perhaps their action is similar during the life of the plant. It is well known that gardeners can produce blue Hortensias by adding iron to the soil. Peony red is turned to a violet by the addition of sodium phosphate, and larger quantities of the same reagent render it blue. The spectrum of the blue and violet pigments has two absorption-bands between D and *b*. These pigments also may be combined with lipochrome yellow, thus producing the colour of the berries of *Ampelopsis*. Hansen does not refer to the red, blue, and violet colour granules which occur here and there in flowers and fruits. He assumes, therefore, only four fundamental pigments:—Soluble yellow, lipochrome yellow, flower-red, and chlorophyll green. He opposes the view that all colours are derived from chlorophyll green, since their spectra do not agree. The change of colours of green fruits and green leaves in autumn he accounts for by the destruction of the chlorophyll, and either the simultaneous formation of new pigments or the unmasking of lipochrome which existed previously, but which was concealed by the chlorophyll. Brown decomposition products cooperate in the production of the autumnal colours.

V. A CONTRIBUTION TO THE QUESTION OF THE IMMORTALITY OF THE PROTOZOA.

PROF. AUGUST WEISMANN has recently given, in the "Biolog. Central-Blatt" (vol. iv., pp. 650 and and 677), a summary of his views on the life of monocellular animals. He concludes that—

1. The controversy whether it is proper in cases of the fission of Protozoa to pronounce mother and daughter as one and the same individual, or as distinct beings, is a mere logomachy. It has a deeper meaning only when we recognise that in these monocellular beings there is no "individual" in the same sense as in the higher organisms. Indeed our abstractions—such as "generation," "mother," "daughter"—are not at once universally applicable, as they are artificial concepts, and not things existing in Nature.

2. The idea of a "senescence" of monocellular animals is not tenable. Physiologically speaking there is a profound difference between the monocellular and the polycellular animals, in the fact that the latter only wear themselves out by living, and proceed to a natural death. The monocellular animals are never so modified by the transformation of matter that life becomes impossible. The monocellulars have no physiological death; their bodies are immortal.

3. Conjugation in the monocellulars and the process of fecundation in the polycellulars are analogous processes, and cannot be regarded as processes of rejuvenescence in the sense of an avoidance of physiological death. This latter occupies a quite different place in ontogenesis, and has nothing in common with these processes.

4. The body of the monocellulars corresponds to the germ-cells of the polycellulars. The sexual propagation of the latter may, with certain limitations, be viewed as an alternation of generations. We have first a generation of monocellular beings,—the germ-cells,—and next a generation of metazoic individuals, which again reproduce, in a non-sexual manner, a generation of monocellulars. The state of the case is more accurately represented by the conception that we have here before us an infinite series of monocellulars, the germ-cells, each generation of which splits off a metazoic individual or produces it as a bud. At any rate

we trace along with the infinite chain of monocellular generations a corresponding number of individuals of a higher order,—polyzoic individuals,—which, unlike the monocellulars, do not emanate directly from each other, but only through the mediation of mono-cellular beings. These individuals of a higher order, alone, have a physiological end—a natural death. The monocellular generations—germ-cells—are potentially as immortal as the Protozoa or other independent, monocellular organisms, since they are not absorbed in their buds, the Metazoa, but split off from them, living on in the interior of such Metazoa, whence they derive protection and nourishment.

VI. ACCLIMATISATION.

By J. W. Slater.

THIS ungainly word has in practice a very different meaning from that which its etymology would show. As commonly used it means the introduction of any alien plant or animal into a country through human agency. Whether such immigrants had to be gradually adapted to their new home by a series of physiological modifications, or whether they found it equally congenial with their mother-country,—or possibly more so,—is not the question.

Another glance at the word may be useful. It seems to imply, if not directly to connote, that the main reason why any animal or plant flourishes in one country, but perishes in another, is some difference in the *climate*, in the geographical sense of the term. In other words, it conveys the impression that the animal and vegetable population of a country depends solely upon its mean or its extreme temperature at different seasons of the year, upon atmospheric pressure, or upon degree of moisture. Now without ignoring the influence of these physical conditions of life we must remember that they are not the sole, nor even the leading, agencies in determining the flora or fauna of a region. There are good physical reasons why humming-birds are not found in Iceland, Greenland, or Siberia. There are no such

reasons manifest why they might not flourish in Madagascar, in Borneo, or New Guinea, as well as in Guatemala or Brazil.

I said above "the introduction of a living species through human agency." I might have added "intentional or accidental." It must not be supposed that man has knowingly, and of set purpose, selected as his companions those living beings which have accompanied him in his wanderings. Far from it: as proof to the contrary we may mention merely the cockroach and the grey rat—Norwegian of earlier writers, Hanoverian of Charles Waterton, but more truly and more significantly Russian! Man would no more wilfully acclimatise such creatures than he would the smallpox or the cholera.

It is often thought that acclimatisation is fostered and recommended by scientific men. Such is by no means the case. The genuine zoologist or botanist looks upon the introduction of alien species into any country with as little pleasure as the classical scholar regards the interpolation of spurious passages in some ancient author. Even here in England doubts have already arisen whether certain plants are truly native or whether they have been artificially introduced. That the consequences of the artificial immigration of plants and animals may teach us certain grave biological lessons is a partial compensation for the obscurity which it is occasioning in organic geography I admit. But none of us would have made the experiment. No savant, no scientist—why have we no genuine English term for such men?—would have carried goats to St. Helena, rabbits to Australia, or "cabbage whites" to North America, merely to see what would happen.

We must remember that "acclimatisation" is a very serious thing—far too serious to be left to the indiscretion of individuals. We are justly warned that even the extirpation of existing forms of animal and plant life is a task which ought not to be undertaken with a light heart and without well counting the cost. But the risk in introducing some alien species is tenfold graver; the step once taken may prove, as far as man's present resources are concerned, irrevocable, and the consequences cannot in the least be foreseen. Of this I shall presently give some examples.

Perhaps the first lesson to be learnt, scientifically speaking, from our present experience in acclimatisation is the fallacy of one of the dogmas of the Old Natural History. It was formerly held and taught that the plants and the animals of any given country were especially, and by

particular arrangement, adapted to the soil, the climate, and all other circumstances of that locality. Hence it was supposed that, if transplanted to any other country, they would be less prosperous than at home, and that, conversely, species brought from elsewhere would maintain their ground with difficulty, if at all.

This doctrine, it may be remarked, involves almost of necessity the theory of a plurality of centres of mechanical creation, or otherwise a series of elective migrations and transformations which in their outcome approach very nearly to Evolution.

There are, indeed, many cases where the plants and animals of one country—the former more especially—seem limited to their original locality. Thus the durian and the mangosteen of the Malay Islands utterly fail in the West Indies, and the shaddocks of the Azores and the Antilles are "flavourless as turnips if compared with those of Bangkok or Labuan."

But there are no less signal instances to the contrary. The thistle brought from Scotland to Australia grows there with a luxuriance quite unknown in its native soil. Even the sweet-brier—which is nowhere exceedingly common or rampant in Britain—is becoming in New South Wales a serious nuisance which the farmer and the gardener are obliged actively to combat.

Nor are these exceptional cases even among plants. With animals there is still less difficulty. The rat multiplies in every corner of the globe where it has penetrated no less readily than in its original home on the Wolga. The rabbit, foolishly—or I might say criminally—turned loose in Australia has proved itself an almost unlimited curse. The sparrow, acclimatised in the United States, in Australia, and in New Zealand, contrary to the advice of judicious European naturalists, has not only established itself, but is seriously interfering with the original bird-population. Descending lower in the scale—if I may so say—of animal life, it is certain that the cockroach, or "black beetle" of unscientific insect-lore, is not indigenous in Britain. It is no less certain that its extirpation is about as unlikely as the conversion of the Anti-Vivisectionists to common sense and common honesty. Blood-sucking gnats, according to Baron Osten-Sacken, were only introduced into the Sandwich Islands about 1828 to 1830: they have since spread, and are becoming a serious nuisance. The same eminent authority states ("Trans. Entom. Soc. of London," 1884, p. 492) that the two-winged insects popularly "lumped"

together as house-flies, such as *Musca domestica* and *Stomoxys calcitrans*, "have been imported into Chili, Australia, and New Zealand, where they were not indigenous," and where, it may be added, they are multiplying and growing formidable. The United States, even, seem to have been originally free from this plague. Hence it may be safely asserted that the aboriginal plants and animals of any country are by no means necessarily confined to that country, but that when intentionally or accidentally transported elsewhere they may flourish as well as—or even better than—at home.

This latter portion of the proposition is merely an extension of the observation of Dean Herbert, that we do not of necessity find plants growing in the soil or the station best suited for their wants, but often where they are most secure from the rivalry of encroaching species.

I am next compelled to bring forward a consideration which will, I fear, lay me open to the charge of pessimism. There is scarcely any instance where a beautiful, a useful, or even a harmless plant or animal has been accidentally introduced, and where, if imported purposely, it has been able to dispense afterwards with man's care and protection. On the contrary, the species most commonly and easily naturalised are weeds and vermin. This is a striking and a most distressing fact, shadowed forth in the primal curse:—"Thorns also and thistles shall it bring forth unto thee."

I may be asked for a definition of "weeds" and of "vermin." These names are applied to organisms which satisfy neither our æsthetic nor our economic wants, and which are often actively injurious to our persons or to our property. Decided beauty may make us overlook uselessness, and manifest utility makes us condone ugliness. But the injurious plant and the harmful animal, even if beautiful,—a very rare case,—are invariably written in the *Index epurgatorius*. There is, of course, scope for some little difference of opinion as to what species are ugly and which are hurtful, but these dissidences do not affect the general principle.

We have to look yet a little further. To the very essence of a weed or a vermin belong great reproductive power, tenacity of life, and adaptability to varying conditions. But for these last attributes ugliness and uselessness would escape notice, and positive harmfulness would be practically neutralised. Now the misfortune is that beautiful or useful organisms rarely possess these features in any marked extent, whilst ugly and useless or pernicious species manifest

them very strongly. Surely a grim satire on the "survival of the fittest"! Whatsoever we would wish to destroy survives, sets us at defiance, and spreads round the globe like a pestilence. Whatsoever we wish to preserve taxes our constant efforts, is often in danger of extirpation, and rarely—very rarely indeed—succeeds in spreading spontaneously into new regions. It is easy to enumerate beautiful plants, such as the lily of the valley and certain of the choicer ferns, which are assuredly disappearing from the British flora.

In like manner the roller, the oriole, and the bee-eater have vanished from our fauna, and the kingfisher is surely following them. We need, therefore, scarcely ask why such species do not attend the footsteps of our colonising pioneers?

It may be said that lovely flowers, birds, and insects are extirpated on account of their beauty. A careful examination will show that this is not the fundamental fact. Lilies of the valley in our woods and field-edges are carried off for sale wherever seen. But what a far wider devastation falls to the lot (say) of the groundsel, the thistle, the dock, &c. Every gardener, from the extensive nurseryman to the humblest amateur, massacres these plants by thousands. So does every farmer. They have also other enemies. Their seeds are the food of birds; their leaves are attacked by caterpillars, and their flowers and buds by Aphides. But are they decreasing? We may congratulate ourselves if we can keep them from gaining further ground.

It is surely a difficult problem to say why and how tenacity and the power of multiplication are thus, apparently at least, preferentially linked with ugliness and harmfulness. But, admitting the bare fact, we need not wonder why the plants and animals which we admire should so rarely become accidentally acclimatised.

The main peril of naturalising any species lies in the circumstance that we can rarely judge how its habits and its powers may be modified by novel surroundings. We know now that the diet and the rate of increase of an animal are not points immutably fixed, but are open to change. If a destructive insect is conveyed to a climate where the summer is longer and more decided, it may produce an additional brood of descendants every season. A still more frequent case is that in its original home it may have been kept in check by some parasite or other destroyer. But when transferred to another hemisphere these enemies may not have accompanied it. Hence its increase is, for a time at least,

unbounded. Not a few of the most destructive insects in the Atlantic States of the American Union are old-familiar denizens of Europe, and have there done comparatively little damage. But introduced to "fresh fields and pastures new" they multiplied in a manner previously unimagined.

Herewith is connected a curious fact: the plants, the animals, and the diseases of the Eurasian continent have a much greater tendency to become cosmopolitan than have those of America and Australia. A goodly number of European plants—practically all of them vile weeds—have reached California, Australia, and New Zealand, have there become wild, and are to a lamentable extent displacing the native vegetation. But the instances of an American plant having become naturalised in any part of Europe are exceedingly rare. And so far we think that no Australian plant has established itself in Europe, save under cultivation. In explanation of this fact, which I must take the liberty of calling an unpleasant one, it is said that the flora of the great Eastern continent is composed of the survivors of a struggle for existence more intense, prolonged, and diversified than can have raged in any other part of our planet. Forms which have emerged victorious from such a contest have naturally great odds in their favour when brought in contact with the flora of Australia, of New Zealand, or even of America. Very similar is the case with the fauna.

This brings us to another side of acclimatisation: when we introduce into any country an alien plant or an alien animal we have not simply the old flora or the old fauna *plus* the new comer. We have brought into play a disturbing element, a ferment,—if I may borrow a chemical expression,—and we have thus set up a process of decomposition, so to speak, in the animal and vegetable population of the country. Each new plant that can maintain itself outside the limits of our gardens or fields, each new animal that can exist in a feral or semi-feral condition, intensifies the struggle for existence, and leads to the extirpation of more or fewer native species.

There are those who will thoughtlessly say "Let them fight it out, and let the best win." But the species which succeed in the struggle for existence are not the most beautiful or the most useful,—often quite the contrary. It seems highly probable that though "natural selection" up to a certain point may have served to increase the number of organic species, yet if that point is exceeded its action is rather destructive. In like manner, if competition between

man and man were totally removed, the race would degenerate. But if it reaches such a degree of intensity as it has done in our times, it compels men more and more to fix their sole attention upon what is immediately useful, overlooking all labour which promises greater rewards in the future. In this manner creative minds find themselves at a discount.

How far-reaching may be the effects of the introduction of a single new animal species is best shown at St. Helena and at the Cape of Good Hope. In both these regions goats were acclimatised by European settlers. One of the most prominent attributes of these animals is to browse down seedling trees and shrubs. In consequence, as goats multiplied, and as the old trees in the woods died off, there were no young trees to take their places. The woods disappeared little by little; the shrubs and low-growing vegetation which had flourished in their shade perished likewise. The birds and the insects which found shelter and nutriment in the trees could not survive. In this manner the native flora and fauna of St. Helena have been so completely blotted out that their nature is a mere matter of conjecture.

Still this is not all: when a country is denuded of woods the rainfall, instead of being moderate and regular, is reduced to violent deluges, interspersed with intervals of withering drought. The soil, being no longer held together by the roots of trees and herbage, is torn away by the violent rains and washed down into the valleys and river-beds, whilst the uplands remain barren wastes of shingle and boulders henceforth incapable of cultivation. To this state millions of acres of the finest land in the world have been reduced by acclimatisation!

I think that all colonies should forbid, under the severest penalties, the introduction of any weed, any mammal not living in a state of domestication, and any such bird as the sparrow. The men who brought the thistle and the rabbit into Australia have done more harm to the human race than if they had committed a hundred murders.

VII. A NEW COSMOGONY.

THE celebrated hypothesis of La Place, after having been first generally execrated and then all but universally accepted, is now encountering opposition of a sober and substantial kind. It fails to account for facts as they now are known to astronomers. Hence a new hypothesis is required, and accordingly such a one has been produced by M. Faye, and has been laid before the world in a recent issue of "L'Astronomie."

A brief recapitulation of the facts of the case will be necessary for an understanding of the basis of the new hypothesis.

Neither the aspect of the heavens nor the appearance of the planets gives us the slightest conception of the Solar System. In order to understand correctly we must in thought leave our world, and withdraw to such a distance that we can with a single glance take in the little system the centre of which is occupied by so ordinary a star as our Sun.

Round the Sun there move, at very unequal distances, eight primary planets. Of these planets six have satellites, —*i.e.*, they are the centres of small systems which represent the Solar System on a reduced scale. Thus the Earth has one satellite (the Moon), Mars has 2, Jupiter 4, Saturn 8, Uranus 4, and Neptune (the most remote planet hitherto known) 1. A striking phenomenon in this our own system is, that the Sun revolves on its axis from right to left; that all the planets, without exception, move in the same direction and almost in the same plane—that, namely, of the of the rotation of the Sun; and that they describe almost circular orbits.

Might it not almost be said that all these bodies are animated by one great vortex movement, and that the secondary systems of the Earth, of Mars, Jupiter, &c., are smaller vortices moving in the main vortex? Such was, indeed, the view of Descartes. Although the Solar System generates at present no vortex, it has been originally formed by a vortical movement in the nebula from which it has been formed.

The heavens display here and there a great number of gigantic masses of rarefied matter, resembling the formless mists of chaos which have undergone only the degree of

condensation necessary for the production of a faint light. We generally require a powerful telescope to recognise these nebulæ, but then we may perceive them in the heavens by thousands, and of several different kinds.

The nebula in Orion has no sharply defined form; a more luminous region can be distinguished in the mass in which the condensation of the chaotic material is most advanced. In all other parts the light is faint. We distinguish merely long streams of luminous matter the meaning of which it is impossible to divine.

The nebula in Andromeda is one of the most remarkable objects in the heavens. It has an almost geometrical form, and in its centre it displays a very distinct condensation.

The nebula in Leo shows nebular rings which appear to be in process of formation.

Lastly, the peculiar double nebulæ of Virgo, Aquarius, &c., are evidently not far from their final transformation into stars.

It would not be difficult to increase the number of the intermediate stages, and, *e.g.*, to point out certain nebular stars which are in the penultimate stage of this series of transformations, which begins with a faintly luminous, shapeless mist, and ends with a sun, or with several suns connected in manifold ways. There is no occasion to say that we have not been present at these transformations. Here we resemble the botanist who in a forest can study the trees in their various stages of evolution. Thus the creation of the universe is, in a manner, proceeding before our very eyes. In the beginning, nebular spots which have separated themselves from the universal chaos; ultimately, glowing stars or other orbs so small that we cannot see them, since their formation evolved so little heat that their light is already extinguished.

Let us now suppose that from some cause—of which hereafter—the spirals of a whirling nebular spot are transformed into concentric rings governed by a common rotatory movement. Objects of such a form really occur in the heavens,—*e.g.*, the ring-shaped nebula of Lyra.

If such heavenly bodies are rare it is because they have little stability. It is merely a state of transition. On account of the differences in their linear velocity which here predominate, and on account of the mutual attraction of their parts, this last cause produces vortices, because they are compelled to follow the same way with different velocities, to coalesce, and to lose themselves in a single nebular mass in which by degrees all the matter of the rings will be

absorbed. This nebular mass, which possesses a rotation in the same direction as the ring, will in turn produce a planet, surrounded by satellites revolving in the same direction and in the same plane.

We have thus a series of nebular rings, some of which display the vertical motion which eventuates in the formation of a planetary mass. At the same time the enormous quantity of material in the midst of the original nebular spot not used up in the rings unites by degrees in the centre, very slowly at first and afterwards very rapidly, thus producing a central orb,—a sun which revolves on its axis in the same direction and in the same plane as the planets.

We see thus how a slow, more or less indistinct, vertical motion can be carried so far that it causes the formation of these circular rings, all concentric and all in the same plane.

For this theory it is essential and sufficient that the solar nebular spot in the first moment was spherical and homogeneous. In such a mass of matter the internal gravitation derived from the attraction of all molecules varies in direct proportion to the distance from the centre. The particles of the small bodies which move in such a medium of inconceivable rarity necessarily describe ellipses or circles around the centre in equal times which is also their distance from that centre. The existence of rings revolving as a whole with the same movement is quite reconcilable with this condition of gravitation. If a rotatory movement has pre-existed some of the spirals which do not differ much from circles will be gradually transformed into the above-described rings, on account of the smallness of the resistance from the centre.

Let us take a further stage. In consequence of the attractive force these rings generally tend to break up to form a globular nebulous mass, which finally includes all the material as the ring. These secondary nebular spots must necessarily have the same direction of rotation as the rings. Phenomena exactly similar to those of the primary nebula will appear,—that is, they will be resolved into concentric rings and then into a central orb. The rings on their part will condense into other very small orbs (satellites) which revolve around each planet, always in the same direction, whilst the planet turns on its axis exactly in the direction and in the plane of these secondary rings.

In this way, therefore, all has proceeded. By a fortunate accident some of the rings of the small secondary system of Saturn have escaped destruction, and have not been

transformed into satellites. M. Faye ascribes their existence to the enormous rarity of these rings and to their rapid rotation.

We should thus have completed the explanation of the Solar System if this system had not a striking peculiarity which is apparently in full contradiction to what has been said. Of the eight planets revolving around the Sun six have satellites, and form thus secondary worlds,—accurate pictures of the Sun-world to which they all belong. According to what has been said all the rotations and revolutions must take place in the same direction, and, what is more, in the "direct" direction. But in the secondary worlds of the two most remote planets, Uranus and Neptune, the rotations and revolutions of the satellites are in the reverse direction,—they are "retrograde."

Are we to believe that the theory just laid down is false? It is not false, but incomplete. And thus we come to one of the most interesting points in the history of Science. Newton and La Place held that all rotations and revolutions must ensue in the same direction. La Place went further, and applied to this question the theory of probabilities. Occupying himself with the planets and satellites as then known, he calculated that if a new planet or satellite should be discovered the probability was 10,000 to 1 that the revolution of the satellite or the rotation of the planet would be in the same direction as all the others—a probability far greater than that of the historical events which we accept with the greatest confidence. The investigation of the satellites of Uranus and the discovery of Neptune have with one stroke annihilated this probability, and therewith the far-famed cosmogony of La Place. This hypothesis deduced all the planets from the Sun. It consequently assigned to the planets and the satellites the same relations and the same direction of rotation and revolution throughout the entire Solar System. In reality they are direct in the inner part and retrograde in the outer.

We will now complete our theory. In the primeval, spherical, and homogeneous nebular spot, where the presence of rings revolving round the centre cannot modify the law of internal gravitation, we saw that this gravitation is modified in direct relation to the distance from the centre. Subsequently the Sun was formed by the coalescence of all the matter which had not been used up in forming these rings; thus an empty space was formed around the Sun. Thereby the action of gravitation in the interior of the system thus modified was totally altered. By the action of

the enormous solar mass—exceeding that of the rings more than 700-fold—the internal gravitation was changed not in the direct ratio of the distance, but inversely as the square of the distance from the centre; and this is the state still prevailing.

In this latter case the manner of the revolution of a ring of dispersed matter becomes completely different. We must not omit to mention that this change does not affect the existence of the ring. Of this Saturn is the proof.

But whilst according to the formerly existing law of gravitation the linear velocity of revolution in these rings increased with the distance, the velocity according to the second law decreased in proportion to the square root of this distance.

In the former case, when the ring has become transformed into a secondary system,—*i.e.*, into a nebular spot with external rings, and ultimately into a planet with its satellites,—the rotation of the planet and the revolution of the satellites will ensue in the same direction as that of the original ring,—*i.e.*, it will be direct. In the second case, the secondary system thus formed will be retrograde.

What must we therefore conclude? It is clear that the planets from Mercury to Saturn, which lie in the central region, have been formed according to the first law, when the Sun did not yet exist, or at least had not assumed a preponderating mass, and that the planets which lie in the outer and far more extended region were formed after the origin of the Sun.

If it should be discovered that Venus has a satellite, its motion must be direct. If a planet is discovered beyond Neptune, its rotation and that of its satellites will be retrograde. We have thus arrived at a proposition of extreme importance: *the Earth is much older than the Sun.* Were it otherwise, as according to La Place its origin was subsequent to that of the Sun, the aspect of the heavens would be entirely different. The stars would rise in the west and set in the east, and the Moon would have a retrograde movement like the satellites of Uranus and Neptune. We will add that they were formerly further remote from the centre than at present. For when the matter which lay outside the Earth's orbit passed over it, in order to unite in the more central regions for the formation of the Sun, then, as the attraction of the latter gradually obtained the supremacy, the period of the planets within the orbit of Uranus would be accelerated. These planets approached nearer to the Sun at the same time as their satellites withdrew further from their respective primaries.

Finally the present state of things became established, and its characteristic stability, as the mass of the Sun, having become enormous, was able to attract nothing more of the original nebular mass, and had rendered the space around it a void.

The universe has arisen out of chaos,—that means from an exceedingly rarefied, formless mass of matter, which filled a wide space and moved in various directions, in consequence of which the chaotic material became separated into distinct masses. By the progressive condensation of these masses of chaotic material towards certain centres of attraction have been formed the innumerable stars. Their incandescence comes from the heat developed during the process of their formation. Their stock of heat is limited, and ultimately they will go out.

Among all the infinitely distinct systems which have arisen by the consideration of this primeval chaos our Solar System may be regarded as a quite special case. The original nebula whence it was formed was spherical and homogeneous. As it became separated from other parts it took on traces of a slow vertical movement. These movements soon regulated themselves in virtue of that peculiar law of internal gravitation due to its form and homogeneity. Nebular rings were formed in the same plane long before the appearance of a central condensation. They produced the nebular masses, which also moved around their common centre in the same direction and in circular orbits.

The secondary systems formed in the same manner within this nebula may be sharply divided into two classes,—those which preceded the formation of the Sun, and which revolve on their axes in a "direct" manner, and the most remote secondary systems which were formed after the Sun, and which revolve in the retrograde direction. These striking phenomena presented by our Solar System are doubtless a rare exception in the universe, though they are merely the natural consequences of the original conditions and of the laws of mechanics.

With full right does M. Faye point to the importance of the proposition that the Earth is much older than the Sun. We cannot help, in passing, referring to the agreement of this view with the Mosaic cosmogony and with other ancient traditions.

But to the biologist, and we think we may say to the geologist also, the new hypothesis and its consequences must be much more satisfactory than that of Laplace.

A number of phenomena, both of organic geography and of palæontology, seem to indicate that life was first manifested on our globe in the Arctic regions, and extended gradually southwards, or, as certain neologists would perhaps say, *austrad*. But to this view there was one very serious objection. As far as we can judge, the fauna and the flora of genial climates could not exist in the Polar regions, whatever might have been the temperature, on account of the months'-long nights. But if we conceive of the Sun as a vast rarefied mass extending as far as the present orbit of Venus, and even beyond it, though shining with a less intense light than it now does, it is obvious that the long Polar nights of the present order of things could have had no existence.

There is another still more important. All our readers will be aware of the indiscreet raid which certain physicists have made upon geology and biology, asserting that if these sciences could not do with a shorter time than five hundred million years to account for the past changes in the Earth and its organic inmates, "so much the worse for geology and biology."

For our own part we never felt greatly alarmed at these calculations. It has been said that the Sun cannot have existed longer than a certain term of years, and that the Earth must necesssarily be younger. If M. Faye's hypothesis takes the place of that of La Place,—and it certainly accounts better for recognised phenomena,—the bases upon which the above-mentioned calculations were founded must entirely disappear.

Perhaps when astronomers and physicists have settled such comparatively simple questions as the temperature of the Sun, and even its distance, it may be time for them to lay down the law for biologists.

VIII. THE RELATIONS BETWEEN THE STATION OF PLANTS AND THE STRUCTURE OF THEIR ORGANS.

THIS subject has been recently studied by Professor Volkens, who has published a summary of his results in the "Annals of the Royal Botanical Gardens at Berlin" and in the "Naturforscher." He has especially investigated the action exerted by dry stations and climates upon the structure of the vegetative organs. Three methods for the examination of these relations are possible, and they have all been employed by Volkens. Either we may compare specimens of one and the same species, but from different stations, or we compare all the species of an order (or the orders of a family), or, lastly, all the typical plants of certain dry regions are submitted to a comparative examination.

In opposition to Sorauer's hypothesis, that evaporation is not a physiological but a mechanical process—an interpretation which offers no basis for the explanation of the protective agencies for checking transpiration — Volkens maintains that we have here to do with a purely physical process depending essentially on two factors,—the vapour-tension of the ambient air, and the nature of the evaporating membrane or liquid. As watery vapour is given off, both from the entire surface of the epidermis and through the interstices from the membranes lining the intercellular spaces, the evaporation will be the greater the more the surface and the intercellular system are developed.

The evaporation is greater from the epidermis and from the internal membranes, because the vapour-tension is generally smaller outside of the plant than within it. Under certain circumstances the epidermis requires an especial protection, in order to lessen the evaporation. This is effected both by thickening and cuticlisation of the membranes, and by a sliminess of the cellular juices.

The adaptation to station appears very distinct in *Polygonum amphibium*, two varieties of which, *terrestre* and *natans*, are often formed from each other. Though the stem in the aquatic form is considerably thicker than in the land form, the stem-tissue of the latter is twice as thick as that of the

former, in consequence of the smaller diameter of the central air-channel. The terrestrial form has, besides, stronger collenchymatised rind-cells, not separated, as in the aquatic form, by intercellular spaces. The sheath enclosing the vascular bundles is more strongly developed, and the cells are often thickened until the lumen disappears. The vascular bundles are more numerous, and contain three times as many vessels as those of the aquatic form.

These differences are explained by the circumstance that the shoots of the land plant, exposed to the action of the winds, require a firm mechanical system, while the water-sprouts must be light so as to accommodate themselves to every movement of the water. The greater part of their volume is taken up by air-spaces, and solid elements are almost entirely wanting. The aërial shoots, producing more numerous leaves and existing in a drier atmosphere, evaporate to a greater extent than do the aquatic shoots, and hence in the former we find the system for the conduction of water more strongly developed than in the latter. Evaporation in the land plant is further diminished by the circumstance that the bark is only slightly developed, and that the air-spaces are insignificant.

We see, further, that the natatorial leaves, in order to avoid temporary submergence, by adapting themselves to the movements of the water, are provided with a long, but thin and permanently flexible, stem. The stem of the aërial leaves is six times shorter, and of nearly double the thickness. They are further mechanically strengthened by a tissue which projects like a keel from the midrib of the leaf. As the aquatic leaves are not in the shade, assimilation is in them more powerful, and hence the chlorophylliferous parenchyma is in them more strongly developed than in the aërial leaves. The latter are protected against too intense evaporation by numerous long hairs, pressed closely upon the surface of the leaf. The number of stomata is approximately equal in both forms, though in the aërial leaf they are chiefly on the lower, and in the aquatic leaf on the upper.

The large epidermic cells which occur singly on the upper side of the aërial leaf must be regarded as an especial adaptation to the dryness of the station. Their inner membrane is in a very slimy condition. These cells readily absorb water, and must be regarded as reservoirs which in time of need give off a part of their water and prevent the epidermis and the parenchymal cells from withering.

Further comparisons are next made between different

species of one and the same genus. It appears that *Asperula odorata*, which inhabits moist and shady woods, possesses no means of protection against evaporation. On the other hand, species of the same group (*Asperula arvensis, tinctoria, cynanchica, galioides*) which all affect more or less sunny stations, are provided with more or less developed means of protection: thus the leaves are in some cases narrower, or their margins are spirally curled up, or there are special arrangements in the structure of the mesophyll and the rind. Without doubt the stomata of all plants of most stations are more frequently open than those of plants which have to contend with want of water.

The third method of investigation has been applied by Volkens to the flora of deserts, and especially of the Sahara. One of the groups there most generally occurring are the Leguminosæ, especially the genera *Genista, Spartium*, and *Retama*. These plants are especially enabled to bear the dryness of the climate by their leaflessness.

Our European species of *Genista* and *Spartium* proclaim, by their possession of leaves, that they are placed in more favourable circumstances as regards water. *Spartium scoparium* accommodates itself to the increased heat of the smallness of the leaves on its summer shoots, which are no longer triple, but single. Volkens is of opinion that all the dead and thick-walled elements within the vegetable body form in their totality a reservoir of water.

ANALYSES OF BOOKS.

The Story of a Great Delusion in a Series of Matter-of-fact Chapters. By W. WHITE. London: E. W. Allen.

WE have here a closely-printed volume of close upon 600 pages —not including a copious index—in opposition to vaccination. As might be expected the author makes some good points, not a few bad ones, and introduces much matter of doubtful relevance. He is fairly successful in showing that the statements popularly circulated concerning the former ravages of smallpox are overdrawn. But, like many of the anti-vaccinators, he forgets that the public horror of smallpox is not based upon the death-rate only. No statistics show the number of persons blinded by that disease—a result worse than death both for the individual and the community. Nor is disfigurement a mere sentimental evil. Let a pock-marked and a non-pock-marked person apply for any situation or appointment, the odds are heavily against the former. Hence the contention that the years of greatest smallpox mortality are the years of least total mortality, if true, is of exceedingly little moment.

Mr. White has the best of the argument when he shows that the introduction of vaccination coincided with a temporary decline of smallpox in the early part of the present century, and that it hence obtained credit for a result which had set in before Jenner's discovery. In fact, if we consider how small a proportion of the population was vaccinated up to the year 1830, we cannot ascribe the improvement to this operation without crediting it with a vicarious influence of great power. The author further raises the question, very pertinently, Which is the true vaccine matter? Is it the original idiopathic cow-pox or horse-grease, cow-pox or unmodified horse-grease, or smallpox refined by being passed through the cow? All these have been in use more or less at different places and times, and have been transmitted from one human patient to another. Hence the question is not unnaturally put by the sceptical, Which of all these is the real safeguard, or are they all efficacious?

But Mr. White's pleas are not by any means all equally happy. Thus he quotes approvingly from Mr. J. Gibbs the following passage:—"Cannot they who believe in vaccination protect themselves? Nobody seeks to hinder them. . . . In their anxiety to coerce others compulsory vaccinationists demonstrate

their own want of faith in the prescription which they assert affords complete security from smallpox."

To these brave words we may reply that the upholders of compulsory vaccination, when an epidemic of smallpox breaks out, are liable to be taxed *ad libitum*, by the Asylum's Board, to isolate the sick and to prevent the further spread of the infection. Further, we may take the somewhat analogous case of conflagration, which the author himself elsewhere brings forward. There are certain methods by which wood, paper, or textile goods can be rendered uninflammable. If by accident there falls upon such protected material a lighted match, or a spark of fire, they do not become ignited. But if these prepared matters are thrown into a furnace, or heaped up with unprotected wood, &c., and a light is applied to the latter, the protection proves insufficient. Just so the vaccinated person may object to living in contact with an unvaccinated multitude who form a pabulum for the epidemic.

Mr. White seems to us in error when he argues that vaccination is worthless because the exaggerated anticipations of its early promoters have been refuted by facts. No one now contends, as was done by the friends of Jenner, that vaccination renders the subject for ever insusceptible of smallpox. Unless that view had been abandoned, whence the necessity for re-vaccination? But it is obvious that a degree of protection which falls far short of life-long immunity may yet be of very considerable value.

In answer to the assertion that vaccination is useless, we may ask when and where it has ever had a fair trial? or, in other words, when and where has an entirely vaccinated community existed? If it can be shown that smallpox is capable of making its way into such a community, we will at once acknowledge that the "Jennerian rite" is ineffectual. In the meantime we submit that the best means of bringing the question to this ultimate or crucial test would be the cessation, or at least the suspension, of the agitation.

As regards the communication of other diseases by vaccination, whilst we admit that it has actually taken place, we must urge the utter want of proof that the great increase, *e.g.*, of infantile syphilis complained of is exclusively, or even mainly, to be traced to this cause. Nor should it be forgotten that the Anti-Vaccinationists, if not entirely identified with the defenders of syphilis, are at least linked with them in very close alliance.

The imputation that vaccination is merely upheld by the faculty from interested motives is repeatedly conveyed throughout this work: now without asserting that medical men may not have their judgment warped by self-interest,—just as it may be the case with political agitators,—we must remember that the emolument derived from vaccination is so small that, if it has any effect at

all in diminishing smallpox cases, medical practitioners in defending this precautionary measure are very literally "fighting against their own bread and butter."

Mr. White's views on the ætiology of smallpox are peculiar. He tells us that "smallpox, as naturally developed, is a crisis of impurity in the blood." This is what Comteans would pronounce a metaphysical explanation. Impurity of the blood, whatever that may mean, has surely existed at all times; but, in the absence of the specific variolous poison, it does not produce smallpox.

He ascribes the abatement of smallpox to "a progressive change in the diet of the people,—to the substitution of tea for malt liquors, and to the displacement of arid fare by potatoes." Again, he writes, "I am disposed to ascribe the abatement of smallpox, which set in toward the close of the last century, to the better blood of the people, ameliorated by the increased consumption of tea and potatoes." Yet though the consumption of tea has greatly increased, and that of potatoes has certainly not diminished, smallpox has again increased, and has repeatedly taken an epidemic form.

As to the irrelevant matter in the volume before us, it is abundant. The strictures on Jenner's private character are for the most part quite beside the question. Granting his shyness, his indolence, his arithmetical incapacity, his being "anxious, fitful, and helpless,"—all these prove nothing for or against the utility of vaccination. Even John Hunter, as having been Jenner's master, comes in for a share of abuse. From the language used, and from another passage, we should suspect Mr. White of a leaning to "Bestiarianism." Another mass of irrelevance is the chapter devoted to William Cobbett!

What we most object to in the present author, and indeed in the bulk of anti-vaccinationist authorities, is that they write not as men of Science, but as political partizans—as agitators. They do not calmly and judicially set to work to demonstrate the inefficiency and the dangers of vaccination; they seem to have set out from theories of "conscience," "liberty," &c., and then to have sought for scientific evidence as a support. We fear it may be deduced, from certain passages in this work, that the author and his friends would still feel free to carry on their agitation even if neither failures nor dangers ever resulted from vaccination.

We do not see that Mr. White fairly meets the objection that compulsory education jutifies compulsory vaccination. We, for instance, are compelled to pay School-Board Rates though we conscientiously believe that *any* form of education administered on the principle of "payment by results" is individually and racially destructive. Still this our belief, or rather knowledge, does not warrant our refusal to pay the school-rate until such

time as the Committee of Council on Education comes to its senses. Why should not our conscience be equally respected with that of the Anti-Vaccinationist?

High Pressure Education. Being an Exposition of the Evil Effects upon the Rising Generation of Hurry and Worry at School, with Suggestions. By F. CHURCHILL, M.B., F.R.C.S. London: Harrison and Sons.

THIS pamphlet scarcely justifies the hopes which its title seems to inspire. It contains, indeed, much of which we cordially approve, but at the same time it is not free from matter against which we must emphatically protest. Sometimes, too, the author is silent where outspeaking would have been the more excellent way.

He begins by reference to the observations of the medical staff of children's hospitals, concerning the "multiple forms of brain-mischief," the increase of headache, lassitude, pallor and sleeplessness, with brain irritability and chorea, which appear among their patients during recent years. From these evils he says, with perfect truth, that "the children in our Board Schools have suffered under the existing system of payment by results." This—and we wish Dr. Churchill had emphasized it more strongly—is the plague-spot on our system of National Education.

The author's personal experience warrants him in speaking with authority. He has had fifteen years' constant experience in children's diseases, with an average attendance upon over one hundred Board School children weekly, at the Victoria Hospital for Children.

As additional evils he refers to the want of systematic inspection of the sanitary arrangements of school-rooms. He speaks of the children sitting listlessly under the tyranny of "iron-bound codes."

He notes the frequency with which boys from 16 to 20 come under his care with nervous twitchings of the face, and he invariably finds that such boys "are undergoing a course of cramming."

Dr. Churchill next explains the *modus operandi* of over-pressure upon the brain and upon the entire system, and enforces a training for the body, *pari passu*, with that of the mind. He glances at the high percentage of insanity in England, and quotes the conclusion of Dr. Connolly, drawn from the statistics of insanity, that whilst "priests, painters, sculptors, poets, and

musicians contribute largely to swell the ranks of the insane, those whose minds are engaged in more practical study, such as physicians, naturalists, chemists, &c., seldom become inmates of asylums." He fails, however, to draw the evident conclusion,—*i.e.*, the necessity of minimising the time and effort devoted to the study of words and abstractions, and turning the intellect to the consideration of things. An education based upon Science is therefore no less necessary for national health than it is for training up discoverers and inventors, the class of society whose numbers and efficiency in any country determines its greatness. Had Dr. Churchill duly weighed this part of his subject he would scarcely have written the last sentence of his pamphlet, to wit: —"Then may we hope for the day when mathematics and classics shall stand a chance of competing successfully with athletics and cyclics as the pleasurable pursuit of youths who are determined to make their very best way in the world." Mathematics are of course necessary as a preparatory discipline for the astronomer, the physicist, and perhaps the chemist; but of classics we have had far too much, and it is in consequence of that error that we make comparatively so poor a figure in scientific research. We must cultivate conception and origination in place of expression,—things instead of words,—unless we would as a nation fall hopelessly into the background.

Nineteenth Report of the Board of Visitors to the (Melbourne) Observatory, together with the Annual Report of the Government Astronomer. Melbourne: Ferres.

From this Report we learn that the weather forecasts are now extended to the northern districts of the colony. The Board strongly advise the introduction of incandescent lamps at the Observatory in place of gas, as the heated air is a source of inconvenience.

The death of Mr. Joseph Turner, one of the assistants, is put on record. The deceased had done much valuable work in connection with the revision of the Southern Nebulæ.

Long-continued earthquake disturbances have been felt in Tasmania during the past year, and they appear to be extending towards the southern part of Australia. It is therefore suggested that the Observatory should be fitted up with seismographical apparatus.

Elementary Text-Book of Zoology. Special Part: *Mollusca to Man.* By Dr. C. CLAUS, Professor of Zoology and Comparative Anatomy in the University of Vienna, and Director of the Zoological Station at Trieste. Translated and Edited by ADAM SEDGWICK, M.A., with the assistance of F. G. HEATHCOTE, B.A. London: W. Swan Sonnenschein and Co.

IN considering this work we can take notice merely of what is officially before us. Consequently the author's reasons for the classification he has adopted, and for the positions which he has assigned to certain groups, cannot here be brought into question. His position with reference to Organic Evolution must also be passed over as not distinctly apparent.

Passing at once to the end of the book, we find the author's views as to the place of mankind in the animal system mainly satisfactory. He states that the notion which formerly was so widely held, that man belongs to a special natural kingdom, above and outside the animal kingdom,—may now be completely put on one side as incompatible with the spirit and method of natural science." He pronounces that the peculiarities of man as compared with the apes "cannot be regarded as fundamental distinctions, but must rather be ascribed to gradual deviations, since there are still greater differences between the highest and lowest apes." He supports this view by showing that the morphological points formerly brought forward in proof of a profound difference of kind between man and ape have all been found wanting. And though he diagnoses man as possessed of "reason," he yet concludes, with Wundt, that "the mind of Man differs from that of beasts only in the degree of development which it has attained."

Still it may be contended that Prof. Claus does not assign to man any distinct position. He appends him to the order Primates, justly cancelling the two delusive Cuvierian orders "Quadrumana" and "Bimana." But he places him neither in a family nor a genus of the highest, or Catarrhine, sub-order.

The question whether Man is the highest mammalian form, as commonly supposed, or whether that position should be assigned to the cats, as contended by Profs. St. George Mivart and—we believe—by C. S. Minot, is not raised.

Concerning the unity of human forms no opinion is given—a prudent reservation. Nor have we any decision as to the number of the characteristics of the human races. Prof. Claus merely quotes on this subject the views of Blumenbach and of Cuvier, and briefly mentions the efforts of Retzius to found a more scientific classification.

A careful examination of this book will convince the reader that, as far as its compass allows, the morphology and the

embryology of the principal groups are accurately and clearly expounded and well illustrated. There are no fewer than 702 woodcuts, well executed and taken from the first authorities, such as Kölliker, Gegenbaur, Balfour, Hyrtl, &c.

As regards the geographical distribution of animals it would, in our opinion, have been well if the author had adopted the system of Wallace and Sclater instead of giving such localities as the "New World," the "Old World," &c. Thus, under the Psittacidæ, we read, "Most of the parrots belong to America." Had Prof. Claus written "belong to the Neo-tropical Region" he would have obviated a possible misinterpretation.

Upon the whole, however, as far as can be judged from the volume before us, we must pronounce the work an admirable exposition of modern zoology.

Dismissing now the author and the subject-matter, we must turn for a moment to the translators and to the language employed. There has latterly been manifested, both in Britain and in America, a tendency to overload zoological works with unnecessary technical terms, of Greek and of Latin origin. This, we submit, is much to be regretted. It can no longer be assumed, as was perhaps the case a century ago, that every student of Natural Science is a classical scholar. On the contrary, the separation between these two spheres of study is daily widening. Why, then, should such books as the one before us not be written in a language intelligible to such as "know little Latin and less Greek"? Technical terms we must have, but a very large proportion of them might be English, and consequently "understanded of the people." Let us take an example: we read here that the Insessores are "usually divided, according to their vocal apparatus, into two orders—the singing birds, or Oscines, and the shrieking birds, or Clamatores." Why not simply say "singers" or "shriekers"? Again, with reference to the different state of development of birds when hatched, it is here written that some "at once follow the mother on land or into the water (præcoces); others leave the egg-membranes very early (altrices)." Now what extenuation is there for the coinage of the terms "præcoces" and "altrices," when "nest-quitters" and nest-sitters" would have expressed the facts much more precisely? The horrible terms "arctiodactylate" and "perissodactylate" might in like manner be advantageously superseded by "even-toed" and "odd-toed." The more we make the natural sciences matters of verbal memory, the more do we impair their educational value.

Practical Physics. By R. T. Glazebrook, M.A., F.R.S., and W. N. Shaw, M.A., Demonstrators at the Cavendish Laboratory, Cambridge. London: Longmans, Green, and Co.

Physical manuals and handbooks, each duly fitted with a tail-piece of the questions set at this or the other examination in years bye-gone, are threatening to become as great a nuisance as the corresponding class of books on chemistry have been. The work before us, we are happy to say, is of a quite different stamp. The authors do not propose to cram readers with a mere word-knowledge of instruments, processes, and results, but they teach the true student the art of learning by experiment.

The plan in use in the Cavendish Laboratory is one which deserves to be more widely known and followed in this country. It requires, of course, a complete set of apparatus; but any department of physical science taught without apparatus, and consequently without experiments, had better not have been taught at all.

The present work is a collection of the MS. details of the different experiments conducted in the elementary classes in practical physics. The authors, in their very interesting Preface, tell us that in their course of instruction the apparatus referred to in each section is placed together on a table. The students are arranged, for the most part, in pairs, and before each day's work the demonstrator in charge of the class assigns to each pair of students one experiment. A list suspended in the Laboratory shows the names of the students and the experiment assigned to each, so that each member of the class can know the section at which he is to work. He is then set before the necessary apparatus with the MS. book for his guidance, and if he meets with any difficulty it is explained by the demonstrator. The results are entered in books in a form provided, and after the class is over these books are collected and the entries examined. If the entries are correct a new section is assigned to the student; otherwise a note of the case is made in the class list, and the student's attention is called to it, or if necessary the experiment is repeated.

We may safely say that if this method of instruction is persevered in we shall have a crop of discoverers in physics springing up in place of men who have merely absorbed the results of their predecessors.

Our Insect Allies. By THEODORE WOOD. London: Society for Promoting Christian Knowledge.

THE author of this work takes extreme ground. Along with very instructive lessons, he ventures to assert "that not only is no insect absolutely injurious to our interests, but that there is none which, were we fully acquainted with its life-history, might not in some manner be utilised for our advantage." We are entirely with him when he points out the benefits which certain species confer upon us, and when he pleads for their protection. It is always painful to us when taking a morning walk to notice the number of such useful creatures as Carabs and Geotrupes which the British workman has crushed when on his way to his daily employment. But we must never forget that the great claim of many species—not merely insects, but animals in general—is that they rid us of others.

Mr. Wood says:—"If by a single word, for instance, we could sweep the Aphis or the cabbage-butterfly from the face of the earth, that word ought never to be spoken." Now the damage done by the Aphis and the cabbage-butterfly is so immense that if it is to be compensated, and even outweighed, by any services rendered, those services would have to be of corresponding magnitude, and could scarcely be overlooked. It is in vain to talk of their life-histories requiring to be better understood. The Aphis and the cabbage-butterfly have been most minutely studied,—the latter, for instance, in Herold's "Entwickelungs geschichte der Schmetterlinge,"—but no redeeming feature has come to light. They do not destroy any hostile species; they do not remove putrescent matter. In fact there seems to be no chink or cranny left for any benefit to us. Nor do we find any evil increase when and where they are relatively scarce, and decreasing, on the contrary, when and where they are numerous. It is very true that we occasionally discover some small redeeming feature in the character of such beings as the earwig, in illustration of the old proverb "It's an ill wind that blows nobody good." But quite as often we discover that our animal allies are untrustworthy, and that our enemies have worse attributes than we could formerly have conceived.

Thus Mr. Wood tells us that the good offices of the gnat—and we should presume of all its congeners—far outbalance its bad qualities. Now did these creatures spend their whole lives in the water, there would be some grounds for this assertion; but during their aërial life they not merely make man and various warm-blooded animals miserable alike in polar and in tropical regions, but they are the active propagators of disease; the liquid which they instil into our blood, when biting, is a septic poison.

Mr. Wood forgets that there are different classes of insect scavengers; some which, like the burying beetles and the dung beetles, busy themselves with carrion and excrement alone, and never settle upon our food or our persons. Such are, to the best of present human knowledge, purely beneficial, especially when they bury the offal and the odure upon which they prey in the earth. But, sad to say, these best scavengers are not increasing, but seem to be rather on the wane.

There are other insects which after feasting on diseased or putrescent matter pass directly to our faces. Now what should we think of a community where scavengers, nightmen, and knackers were permitted, without any intervening washing or disinfection, to act as provision merchants, dairymen, sick-nurses, or surgeons? Malignant tumour is often caused by the bite of flies which have been feasting on the remains of diseased cattle.

As an instance of the untrustworthiness of some of our insect allies, the author might have mentioned the cannibal propensities of at least one species of labybird (*Coccinella bipunctata*). We have been often sorry to see with what eagerness the larva of this species preys upon the inactive pupa, and this, too, in cases where there is an ample supply of ladybirds close at hand. Surely this propensity must greatly limit its efficiency as a destroyer of Aphides. The *Telephori*, "soldiers and sailors" of popular nomenclature, which the author does not mention among our insect allies, does not seem guilty of this blunder.

The cannibalism of the ladybirds is an instance of the slight sensibility to pain which the author notices as characteristic of insects. We have seen pupæ which even in the very act of being devoured appear supremely indifferent to the transaction.

We may sum up our opinion of this book by pronouncing it interesting and valuable as far as facts go, but of very questionable authority in matters of inference or of speculation.

Louis Pasteur: His Life and Labours. By his Son-in-Law. Translated from the French by Lady Claud Hamilton. London: Longmans, Green, and Co.

So far as scientific literature is concerned the volume before us may emphatically be called "the book of the season." Biologists and chemists have of course followed the labours of the great French *savant* with an interest not the less sympathetic and appreciative because often critical. But the outside world, educated and cultured, though not specialistic, stands sadly in need of better instruction concerning Louis Pasteur and his life-

task. Did we not see him, in a work noticed in this very number of the "Journal of Science," denounced as a "ghoul?" We are glad, therefore, to find him and his achievements here pourtrayed in non-technical language.

The present edition of M. Radot's biography of his illustrious father-in-law is rendered more valuable by an introduction from the pen of Professor Tyndall.

The leading ideas which Pasteur has followed out in his manifold researches are the old doctrine *omnia ex ovo* and the part played by minute organisms in the changes both of animate and inanimate matter. His studies have therefore led him into the border-land of the two sciences, biology and chemistry,—a region which he has proved to be indeed fruitful. It need scarcely be said that he has been the most persevering and successful opponent of so-called "equivocal generation,"—the origin of life without antecedent life. In not a few cases where previous experimentalists believed that they had succeeded in producing minute organisms from lifeless matter, Pasteur has been able to find some capital flaw in the *modus operandi*. Experiments in the same direction have been performed with every precaution by Prof. Tyndall, and with negative results. Microscopists such as Dr. Dallinger and Dr. Drysdale have further shown that the germs of plants and animals may survive temperatures far exceeding that of boiling water, and may exist where observers less acute and patient found merely a lifeless void. But we may even say that the crucial experiment is being daily performed by commerce on a vast scale. If microbia were capable of originating spontaneously from organic matter we should see the tins of Australian meat and other preserved esculents arrive swarming with life and in a flourishing state of decomposition. But this is not the case except some flaw in the soldering has admitted the air, and with the air the germs or spores which are very rarely absent.

Studies like these naturally led Pasteur to scrutinise the boundary line—if so it may be called—between the organic and the inorganic worlds. For whilst he has been so active in showing that man has not yet succeeded in producing artificially either living beings or the substances essential to organic life, he has nowhere, to our knowledge, proclaimed such a result impossible. On the contrary, he has even thrown out suggestions how this task may be attempted. His contention is that organic products are "atomically dissymmetric,"—this dissymmetry being shown in their power of turning the plane of polarised light. Mineral matter, on the other hand, and the secondary products of organisms—such as those which have been artificially produced in our laboratories, urea, oxalic acid, &c.—have no action on polarised light. He maintains that "the forces which are present and active at the moment when the grain sprouts, when the egg develops, and when under the influence of the sun the

green matter of leaves decomposes the carbonic acid of the air, are of the dissymmetric order." He is inclined to think that "life as manifested to us must be a function of the dissymmetry of the universe or of the consequences that follow in its train."

He suggests the attempt of introducing a manifestation of dissymmetry among the forms of crystals by means of magnets. "At Lille he contrived a piece of clockwork intended to keep a plant in continual rotatory motion first in one direction and then in another." He further proposes, "with the view of influencing the vegetation of certain plants, to invert by means of a heliostat and a reflecting mirror the motion of the solar rays which should strike them from the birth of their earliest shoots."

He is further quoted as saying:—"When the attempt is made to introduce into living species primordial substances, inverse to those now existing, the great difficulty will be to master the tendency proper to the species, a tendency which is potential in the germ of each of them. In this germ, it is to be feared, the dissymmetry of the dissymmetric primordial substances which it embraces will always manifest itself. Ah! if spontaneous generation were possible; if we could form from mineral matter a living cell, how much more accessible would the problem become! However this may be, we must seek, by all possible means, to produce molecular dissymmetry by the application of forces which have a dissymmetric action; we must invoke the action of solenoid or helix."

It is, however, only fair to notice here the criticism of Professor Tyndall. He reminds us, in his introductory chapter, that the molecular dissymmetry upon which Pasteur lays such great emphasis is simply a hypothesis to account for a fact—the power of causing the plane of polarisation to rotate. Now previous to 1845 Faraday had succeeded, both by helices and magnets, in causing the plane of polarisation in solids and liquids, previously neutral, to rotate. If such rotatory power is a proof of molecular dissymmetry, Faraday succeeded in conferring this power upon more than 150 substances. But that they were thus brought any the nearer to vitality it nowise appears.

But we must now pass to an apparently very remote subject, the "vaccines,"—as they have been unhappily named—which Pasteur has devised for certain *z*ymotic diseases. The one basis common to Jenner and to Pasteur is the proposition that a man can have ordinarily certain diseases only once in his lifetime, and that if he recovers he will ordinarily enjoy a complete immunity. Ordinarily, for there appear to be exceptional cases in which a single attack of yellow fever, black plague, smallpox, &c., does not permanently exhaust the susceptibility of the patient. But beyond this fundamental proposition, Jenner and Pasteur diverge completely from each other. Jenner observed, or thought that he had observed, that a disease different from smallpox, and not naturally occurring in man, could, if transferred to the human

subject, exhaust his susceptibility for smallpox,—which question has now unfortunately *descended* (not *ascended*, as anti-vaccinationists put it) into the region of politics, and is being discussed in the customary style of agitators. But Pasteur went to work in a totally different manner. He took the infectious matter of splenic fever, and succeeded in *attenuating* it,—that is, in so reducing its malignity that when introduced into a sheep or an ox it did not not prove mortal, but merely occasioned a slight illness. After its recovery the animal thus "vaccinated"—if the very inapproprite term must be used—was proof against the contagion of splenic fever, even if purposely inoculated with the virus in its original unmitigated form.

In the same manner he has dealt with the virus of rabies; he has attenuated it down to such a point that when introduced into the system of dogs it occasioned merely a slight illness, on recovering from which the subjects thus operated upon were found experimentally to be proof against rabies. If this immunity is found enduring, Pasteur will have freed the world from one of the most fearful maladies to which mankind are liable. No reader of these lines is safe, in the streets, in his garden, or even in his own house, against being bitten by some rabid cur, and doomed to a certain and horrible death,—all the more horrible because of the deceitful respite of months which the victim often enjoys. Surely, we repeat, the man who delivers us from this scourge deserves our utmost gratitude.

As an instance of the dangers which Pasteur encountered in his researches on rabies we may quote the following case:—"Not long ago a veterinary surgeon telegraphed to him—'Attack at its height in poodle and bulldog. Come.' . . . The two dogs were rabid to the last degree. The bulldog especially, an enormous creature, howled and foamed in its cage. . . . Two youths threw a cord with a slip-loop over the dog as a lasso is thrown. The animal was caught and drawn to the edge of the cage. There they managed to get hold of him and to secure his jaws; and the dog choking with fury, his eyes bloodshot, and his body convulsed with a violent spasm, was extended upon a table, and held while Pasteur, leaning over his foaming head, *at the distance of a finger's length*, sucked up into a narrow tube some drops of the saliva. . . . Witnessing this formidable *tête-à-tête*, I thought Pasteur grander than I had ever thought him before."

Yet this man, so ready to expose himself to the most fearful danger in the cause of Science and humanity, is so averse to giving needless pain that he utterly eschews "sport,"—the destruction of animals for pastime. Such are the "investigating sneaks," as they are absurdly called by Bestiarians.

Electricity, and its Manner of Working in the Treatment of Disease. A Thesis for the M.D. Degree of the University of Cambridge. By W. E. STEAVENSON, M.D., M.R.C.P., M.R.C.S. Eng., &c. To which is appended an "Inaugural Medical Dissertation on Electricity, for the Degree of Doctor of Medicine of the University of Edinburgh. Written in Latin by Dr. ROBERT STEAVENSON, 1778, with a Translation by the Rev. F. R. STEAVENSON, M.A. London: J. and A. Churchill.

THIS work is not, as we at first feared from the title on the cover, an elementary manual of electricity, but an investigation of a subject as yet very imperfectly understood—the action of electricity upon the animal economy in disease. Curiously enough, the medical application of electricity, instead of having made important advances, has fallen into neglect. As the author remarks,—"The knowledge of many of the wonderful effects derived by treatment with electricity a hundred years ago has now faded into oblivion, and is unknown to the practitioner of the the present day." This is the more to be wondered at and regretted, since the electrical appliances which might now be made available in the healing art are vastly improved and extended. Still more is it to be deplored that the medical applications of this powerful and versatile agent should have fallen so largely into the hands of the quacks: but quackery in its various types is now, for a season, lord of the ascendant.

The author thinks that statical electricity in the form of the positive charge is possibly preferable in functional diseases, such as hysteria and nerve prostration. But where organic changes are present the current, continuous or interrupted, has been found greatly superior.

We find here a mention of some very curious facts. Thus, lunatics "offer an extraordinary amount of resistance to the passage of an electric current." Whether this be due to the abnormal harshness and dryness of the skin (as is often the case) or to some unusual condition of the internal organs is not decided. It is here remarked that "many of the good results of electricity have been unattained and entirely disbelieved in because the current has been passed through the body in a hap-hazard way, often with the patient only holding the handles of some kind of electrical machine, which has produced most uncomfortable sensations and sometimes pain, with very little appreciable effect upon the organ it was wished to influence, and which possibly was situate in some remote part of the body." This is too true: we have heard of the attempt made by a charlatan to decompose a urinary calculus by causing the patient to grasp the handles of the machine with both hands.

As to the vexed question of the identity or non-identity of nerve-force and electricity the author inclines to the negative view. He cites as distinctions that nerve-force travels only at the rate of 200 feet per second, whilst electricity may traverse a wire at the speed of 462,000,000 feet per second; that nerve-force is not conductible along a wire: that cold diminishes the conductivity of nerves for nerve-force, whilst it increases the conductivity of both solids and fluids for electricity; and that the crushing or compression of a nerve destroys its power of transmitting nerve-force. To this it might be added that the nerves are not superior to other animal tissues as conductors of electricity.

It is mentioned that, according to the interesting researches of Dr. Poore, the passage of a continuous current through the muscles, or the nerves supplying them, increases their susceptibility to the stimulus of the will, and also their endurance for voluntary muscular action. "He found that a weight of 17 ozs. could be held out in the hand at right angles to the body for double the time when a continuous current was passed through the arm than when no electricity was used. He also found that the force of voluntary muscular action measured by the dynamometer could be very greatly increased by the passage through the arm of a galvanic current. It was found that galvanism increased the force of the squeeze of his own hand about 11 lbs."

Dr. Steavenson even suggests that racial and national characteristics may be influenced by the electric conditions of climate.

The last passage which space allows us to notice is only too significant. The author refers to a hint which he threw out in a previous thesis on Asthma that "possibly the varying electrical conditions of the atmosphere might explain the seemingly unaccountable conditions which influence and produce an attack of the disease." But he further adds:—"Since then the struggle for existence which young physicians have to maintain has prevented me devoting the time I could have wished to investigate this theory further." To those whose eyes are open this simple sentence is a very handwriting on the wall of that huge sham, our modern civilisation. To those who cannot, or rather will not, see, the interpretation would be useless.

Dr. Steavenson in this thesis does good service by calling the attention of competent and qualified physiologists and physicians to an agency which has been too long abandoned to quacks.

Records of the Geological Survey of India. Vol. XVIII., Part 1, 1885.

THIS issue contains the Annual Report of the Geological Survey and of the Calcutta Geological Museum for the year 1884.

Mr. R. Bruce Foote contributes notes on the district between the Singareni Coal-field and the Kistna River. He mentions a bed of iron ore of very rich quality situate at the distance of half a mile from the southern boundary of the Singareni Coal-field and near the great limestone beds of Kadapa age.

Concerning the diamond deposits along the left bank of the Kistna, the author is of opinion that this industry is "crushed by the heavy royalty levied and by other absurd restrictions imposed by certain people at court in Hyderabad." He adds that "there is certainly no geological reason why the undisturbed gravels should not be as rich in diamonds as the portions of the same beds explored in past times.

Mr. D. La Touche furnishes a note on coal and limestone in the Doigrung River, Assam. He finds the coal,—at least the sample taken at the outcrop,—very poor in quality, yielding on analysis 48·76 per cent of ash and only 15·10 per cent of fixed carbon. The limestone he thinks sufficient to supply the wants of Upper Assam.

Mr. W. T. Blanford, F.R.S., gives a paper on "Homotaxis, as illustrated from Indian Formations," being a reprint of his address as President of the Geological Section of the British Association, at Montreal.

Second Annual Report of the United States Geological Survey to the Secretary of the Interior, 1880-81. By J. W. Powell. Washington: Government Printing Office.

In this goodly volume we find, among much other interesting matter, an account of the heat-phenomena of the Comstock Lode. The mere fact is well known to all persons interested in Geology, but the explanation is still wanting. It appears that the water which flooded the lower levels of the Gold Hill mines during the past winter had a temperature of 170° F. "This water will cook food and will destroy the human epidermis, so that partial immersion in it is certain death." In spite of ventilation carried out to an extent without precedent elsewhere deaths from mere heat are not uncommon. The air in most parts is very nearly saturated with moisture, and it is very questionable whether it will be possible to push the workings much further down. Depth and temperature seem proportionate, setting aside local divergences, and it would hence seem that the source of heat must lie far below the greatest depth as yet reached, *i.e.*, above 2000 feet. It is calculated that at the depth of 5000 feet boiling water would be reached, whilst in another hot mine, the Rosebridge Colliery, water will not boil above 10,000 feet.

The two theories generally proposed to account for this ex-

ceptional temperature are residual volcanic phenomena and the kaolinisation of the felspar contained in the rock, with fixation of water and liberation of heat. In support of this latter supposition it is urged that flooded drifts have been observed to grow hotter. Experiments, however, seem to show that if this process is going on at all it must be at immense depths. Had the heat of the lode been maintained ever since its formation at the expense of the felspars but little undecomposed felspar could remain. The author of the report seems rather to conclude that heat is conveyed to the lode by waters from great depths.

A survey of the mine, with the view of determining the electric phenomena of masses of ore, is suggested. It is not yet decided whether lode-currents will or will not be of practical assistance to the prospector.

As the only plant which seems to flourish in the desert regions is mentioned the common sunflower, "which thrives anywhere from Maine to Arizona, seeming indifferent to the vicissitudes of climate.

On the other hand, on the "High Plateaus," Mr. Lester F. Ward collected in a single season more than 600 plants, the slopes and platforms being resplendent with dense masses of scarlet, white, purple, and yellow flowers.

The Scientific Roll. A Bibliography, Guide, and Index to Climate. By ALEXANDER RAMSAY, F.G.S., &c. London: W. Swan Sonnenschein and Co.

MR. Ramsay has entered upon an ultra-Herculean task. To index up scientific literature, though a most desirable undertaking, would probably demand the entire time of many persons and would probably involve an expenditure of not less than £20,000. We hope the author may succeed in carrying out his plans; but we fear that even the most industrious and energetic man would find himself overwhelmed by the effort to index even biology.

The work before us begins with an essay by A. R. on diurnal periodicity. Then begins the bibliography of meteorology arranged in years from the 13th century down to 1830. Then follows an interesting memoir by Prof. E. Douglas Archibald on the "Connection between Solar Phenomena and Climatic Cycles." The author in concluding suggests that before long we may come to regard the magnetic needle as a sort of meteorological index. The bibliography is then resumed and carried down to 1881.

We next come to a series of general notes on meteorology, extracted from the works mentioned in the bibliography. Then

follows an index of meteorological subjects arranged under such heads as Aqueous vapour, Atmosphere, Aurora, Climate, with references to the bibliography.

Then under the heading "The Scientific Enquirer" follow a number of questions on biological subjects.

We have also reports of the proceedings of the Scientific Union, *i. e.*, the Conference of Delegates from Scientific Societies which has latterly been held annually during the meetings of the British Association.

We can only repeat our hope that Mr. Ramsay may live to carry out his vast undertaking.

Fresenius' Quantitative Analysis, Vol. II., Part I. Translated by C. E. GROVES, F.R.S. London: J. and A. Churchill.

THIS portion of the work is devoted to ultimate organic analysis. The present edition,—so far as can be judged from the small portion which is formally before us,—is elaborated with the author's well-known care and comprehensiveness, all such improvements and modifications as have won recognition in practice being introduced. A feature—and not the least meritorious one—of this work is the avoidance of irrelevant speculations. Fresenius wisely holds that a treatise on chemical analysis is by no means the place for the ventilation of structural formulæ.

The Metaphysical Aspect of Natural History. An Address to the Rochester Natural History Society, December 10th, 1884. By STEPHEN MONCKTON, M.D., F.R.C.P. London: H. K. Lewis.

FROM the title of this little work we were in doubt what to expect. With the incursions of Metaphysics into Natural Science we have in general little sympathy. We soon found, however, from the preface that the author's object is to enforce two propositions by no means novel, and of more value to the Natural Theologian than to the Naturalist as such. These are:—

"1. That there is in Nature an intelligent will force.
"2. That such intelligent will is the Author and Subject of the Bible."

The second of these propositions is so completely outside our competence that either to assert or to impugn it in our pages

would be a grave act of indiscretion. The first involves teleological considerations which are liable to be instantly met by dysteleology, leading to an interminable and, to the Naturalist, fruitless logomachy. We submit that Science has more to do with efficient than with final causes, which Bacon well designated as "vestal virgins."

In the outset of his discourse Dr. Monckton proposes to the student a difficult undertaking:—"It would be an instructive task for a young member of your Society to work up fully the classifications that have prevailed in Botany and Zoology, grasping the views which were associated with each arrangement, and the corrections that became called for and applied as knowledge became at once more accurate and more wide." We doubt if the possible results of such a study could compensate for the time consumed. How is the modern inquirer to realise the limitations of the knowledge of the older naturalists and the influence of their prepossessions?

Our Corner. Vol. V., No. 4.

THIS journal seems to be becoming more exclusively literary and political. There is an account of some "healing miracles" said to have taken place at the chapel of Knock, in Mayo. Nine cases are given, extracted from the list of cures in Archdeacon Kavanagh's diary. The writer's object appears not so much to examine into the reality of these occurrences as to contend that they are equally credible with the "similar wonders related in the Bible."

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

HOW NOT TO DO IT.

It is commonly supposed that the Local Government Board is constantly exerting pressure in favour of sanitary improvements, whilst local authorities are recalcitrant, and seek every expedient to delay, if they cannot prevent, the needful reforms. As a striking instance to the contrary I may point to Hendon. The Local Board there resolved upon a scheme for treating their sewage, in October last, and made application to the Local Government Board for power to borrow a sum of money for the undertaking. Before this could be granted a certain Inspector of the Board had to come to Hendon to hold an official inquiry. He happened, however, to be taken ill early in November, and Hendon has still to wait for his recovery before an additional step can be taken. The Board has other Inspectors equally competent to hold the inquiry; but no! No one else may be entrusted with the affair. Surely Rivers' Pollution Bills are utter farces if delays are permitted on such frivolous pretexts.

A Ratepayer.

PSYCHOGRAPHY.

Your contributor, "R. M. N.," would have rendered a great service to the perplexed many if he could have shown how the motive power used in Psychography, and other Spiritualistic manifestations, is procured. We "so-called scientific men," who, in a recent article in "Light," are likened to "very clever members of the canine race," have been under the conviction

that the creation either of matter or of energy is exclusively a Divine attribute. Are we, then, to be accused of "arrogance, prejudice, and preconceived opinions" if we hesitate at accepting facts of such a momentous character?

A "SO-CALLED" SCIENTIFIC MAN.

R. R. S., F.C.S.—On examination you will perceive that the matter to which your letter refers is simply an advertisement, and as such, in obedience to the received code of journalistic courtesy, it cannot be discussed in our columns. We should recommend you to forward your criticism to the author in question.

NOTES.

At a meeting of the Pathological Section of the Academy of Medicine in Ireland, it was mentioned that a lioness in the Dublin Zoological Gardens had entirely eaten off her tail, and had then begun to devour one of her paws, when her lamentable condition rendered it necessary to destroy her. Several other instances of self-mutilation in animals, and one in a child, were given.

Dr. A. Penck has recently examined the Pyrenees, and finds that the western extremity of the chain, beyond the valley of the Saison, has never been glaciated. Indirect evidence has been obtained that the eastern portion of the Pyrenees has been repeatedly glaciated on its northern side.

An anonymous writer in "Science" maintains, in explanation of the alleged decay of Science in and about Boston, that "the mental atmosphere of that city has become one of intellectual finish rather than of intellectual earnestness."

A whale, stranded at Luc-sur-Mer ("Moniteur de Calvados"), has been taken to pieces scientifically, the skin and the skeleton being carefully preserved.

"Cosmos les Mondes" gives, under the heading "Physiology," an account of one Achille Barossi, who is said to be able to walk 180 kilometres daily.

Professor Luvini has recently studied "lateral refraction,"—a novel optical fact.

The Sirocco is found to transport nearly 3½ kilos. of iron as fine dust, per 100 million cubic metres of air.

The Bestiarians have made a third attempt to prevent biological research in Oxford, and have been signally defeated.

The world-renowned ruling-machine of the late M. Nobert was exhibited at the last meeting of the Royal Microscopical Society. It has been purchased by Mr. Frank Crisp, one of the Secretaries. The foundation of the machine is the ordinary dividing-engine used in the graduation of circles and sextants: this, by a vast amount of delicate superposed mechanism, is made to

rule lines at a very minute but determinable distance; strange to say the lines are not straight ones, but portions of a large arc; the lines, however, not exceeding one-fiftieth of an inch in length, the curvature is not perceptible. The diamonds used for ruling are worked to knife-edges, in some instances ground, in others chipped, but made with such delicacy that microscopic examination fails to detect any serrations: in this and the glass employed would seem to lie the secret of the fine quality of line produced by M. Nobert. The note-book of the inventor accompanies the machine, and in it the performance of each diamond has been recorded, and much useful information that will probably enable the machine to be used. Experts who have examined the machine since it has been in England do not consider the mechanical contrivances the best that could have been devised; but the fact nevertheless remains that Nobert contrived to execute rulings which have not been equalled. The resolution of the nineteenth band, in which the distance of the lines—according to the measurements of Dr. Pigott—is 112·595 to the inch, and formerly supposed to be impracticable, is now accomplished without much difficulty. There is also an adaptation for ruling the longer and comparatively coarser lines for diffraction plates for spectroscopes.

The death of Charles Vance Smith, of Carmarthen, is announced. The deceased was noted for his skill in preparing vegetable tissues for the microscope: his series illustrating the manuals of Sach and Thomé are well known, and are admirable reproductions of the figures in those works, and of immense value to students unable to procure the specimens for themselves.

M. Arnaud has proved that the orange-red colouring-matter of leaves (erythrophyll) is identical with carotine—the colour of the carrot.

We are glad to find that the London Section of the Society of Chemical Industry has completely condemned the New Rivers' Pollution Bill.

We learn that a new Poisons' Bill has been introduced into the House of Lords. As any conceivable measure of this kind will press heavily both upon the industrial arts and upon scientific research, we recommend that it should be opposed in every possible manner.

According to a well-informed French contemporary the excrements of dogs are now collected in Paris and worked up into peptones and powdered extracts of meat!

According to "Reimann's Faerber Zeitung" a cat which had been accidentally imprisoned for six weeks, in the ruins of a

woollen factory near Aix la Chapelle, was found alive, though much emaciated, and is likely to recover.

"Science" makes some apposite remarks concerning the ordinary microscopist:—"The direction of his studies is determined not by any natural bond between the objects, but by the common quality of minuteness. Imagine anyone deliberately setting out to study whatever he could cut with a knife. We should pity the man who chopped up the sciences according to the instruments he uses. We cannot be brought to regard anatomy as a department of cutlery, nor can we seriously admit histology as a department of microscopy.

Th. Chandelon ("Ber. Deutsch. Chem. Gesell.") shows that egg-albumen is peptonised by hydrogen peroxide, the intermediate products being almost identical with those produced from albumen during pepsine and trypsine digestion. Hence he suggests that the digestive ferments act by forming hydrogen peroxide.

We are requested to mention that the Royal Society of New South Wales offers its Medal and a prize of £25 for the best Memoir (if of sufficient merit) on each of the following subjects:—

Series V.—To be sent in not later than May 1st, 1886. No. 16. On the Chemistry of Australian Gums and Resins. No. 17. On the Tin Deposits of New South Wales. No. 18. On the Iron Ore Deposits of New South Wales. No. 19. List of the Marine Fauna of Port Jackson, with Notes on Habits, Distribution, &c.

Series VI.—To be sent in not later than May 1st, 1887. No. 20. On the Silver Ore Deposits of New South Wales. No. 21. Origin and occurrence of Auriferous Veins and Associated Minerals. No. 22. Influence of Australian Climate in modifying Diseases. No. 23. Infusoria peculiar to Australia.

Series IV., for May 1st of the present year, comes too late. The subjects are—Anatomy and Life-history of *Echidna* and *Platypus;* Anatomy and Life-history of Australian Mollusks; and Chemical Composition of Products from the Kerosene Shales of New South Wales.

The yearly consumption of ardent spirits in Norway has fallen during the last forty years from 20 litres to between 3 and 4 litres per head. Simultaneously the number of criminals in prison has decreased from 249 to 180 per 100,000. In Belgium the yearly consumption of alcohol has risen during the same time from 8 to 12 litres per head, and the convicted criminals have increased from 269 to 648 per 100,000. Norway has, per 100,000 inhabitants, 3300 paupers, 83 lunatics, and 7 suicides;

Belgium 14,000 paupers, 150 lunatics, and 10 suicides.—*Berliner Tageblatt.*

At a meeting of the Academy of Medicine in Ireland the Rev. Dr. Haughton stated that the "nail-biting habit was, in his experience, confined to men." About twelve years ago we had the opportunity of observing a woman, of about 27 years old, who bit her nails viciously. We learn, from mistresses of schools, that the habit is by no means rare among female children.

With the mere "passage of matter through matter" we are all fairly familar, but the alleged passage of a solid through a solid without any breach of continuity having been occasioned cuts away the very ground from under our feet.

Mr. James Davison ("Journal of Anat. and Physiol.") concludes, from a series of observations, that full light, darkness, and the blue ray have no influence on the hatching of the eggs of the blowfly. Pupation ensued in the dark in fourteen days, in full light in twenty-one to twenty-eight days, and in the blue ray not at all. The mature insects appeared in the light in twenty-three days, but in the dark only in twenty-six days. The specimens reared in the dark were smaller and less highly coloured than those reared in the light. An increase of 21° F. accelerated both the hatching of the eggs and the pupation of the larvæ.

Mr. H. H. Nicholson ("Science") has observed that certain snakes (*Pituophis Sayi*), on receiving the shock of an induction-coil, uttered a cry like that of a young puppy.

The following strange passage is said to have recently been printed in an English medical journal, as from a correspondent:—"When I state that after the death of a dog or person who has been bitten by a poison snake, on post-mortem examination there will be found attached to the liver a snake of the same species as the one that bit the dog or person, and if the dog has been bitten twice there will be two snakes, and in one instance the snake put out its tongue, nobody who has never seen it or heard of it will believe it. Yet such is the fact. This is why a person or dog who has been bitten with a snake feels the influence every year at the time snakes awake up from their dormant state."

"Light" writes:—"So eminent a man and moralist as Dr. Johnson was touched by Queen Anne,"—*i.e.*, as a remedy for scrofula. But he was not cured!

Madame Traube-Mengarini ("Du Bois Reymond's Archiv.") has been studying the functions of the brain of fishes. Not the

entire lobi optici are connected with equilibrium and locomotion, but merely a circumscribed spot at their base. Before and behind it are two parts connected with respiration.

"The Medical Press and Circular" has done good service by its exposure of the alleged "faith-healing" operations of the "Salvation Army" in Staffordshire.

M. Dareste has proved, by comparative experiments, that the turning of eggs during incubation is essential to the healthy development of the embryo. Eight eggs kept motionless under an incubator did not yield a single living chick. Eight similar eggs placed under a similar incubator produced six living chicks; the seventh egg, which was opened on the twenty-second day, contained a living, well-formed chick. *Quære:* the origin of the egg-turning instinct in hens during incubation?

Alfred Nehring ("Naturforscher"), on comparing the skulls of pre-historical domestic dogs with those of wolves, finds no essential difference save in the smaller size of the superior canine,—a point in which wolves vary greatly. He considers that the larger races of dogs are descended from the wolf and the smaller from the jackal.

Prof. Campbell Brown, at a meeting of the Liverpool Section of the Society of Chemical Industry, declared his belief that "Examinations would never be able to determine who was the best practical man. They had signally failed to do so in the universities in this country, and probably everywhere else. He believed the system of examinations so enthusiastically carried on at South Kensington was responsible for a great deal of the mistaken energy which had been devoted to this kind of cramming for Science and Art Examinations. But when they looked away from the examinations, and saw what was being done in the way of teaching, they found a very different account. It was not by examinations, but by the teachers looking over the work from day to day and from week to week, and making a report of what was done, that they could pick out the best boy for practical work. In the ordinary examinations a boy might not be very well on the day he had to write his answers. He had known men who were perfectly capable of becoming senior wranglers that could not pass because they had the toothache the night before." The nation is evidently awaking, and then "good night" to the Department.

A spirit is described as saying ("Light") "The butterfly would not recognise in the chrysalis a fellow-creature." The spirit is in error. Male butterflies have been observed keeping guard over a chrysalis from which a female of their own species was likely soon to issue.

Mr. C. W. Irish, C E. ("Kansas City Review") refutes the contention of Mr. Moore that the Romans had colonised America and left there traces of their language.

Captain S. Bent, in the same journal, shows that the plains and table-lands of Utah, Nevada, and Arizona, owe their barrenness to no accidental or remediable cause, but to immutable laws of Nature.

Mount Roraima, in British Guiana, at the height of 5600 feet above the sea-level, is said to be a perfect garden of orchids.

Says Mr. C. C. Massey ("Light"), "It is always difficult to say where moral unveracity shades off into the inaccuracy which has its origin in defects of intellectual habit or temperament."

Dr. A. Bronold ("Zeitschrift Land Vereins in Bayern") finds that electricity has a threefold influence upon the growth of plants,—as an illuminant, as decomposing the constituents of the soil, and as ozonising the air. By the joint application of this triple agency to certain ornamental plants and to strawberries he effected growth, strength, and health, exceeding by two or three times that obtained under natural cultivation; larger size and better development of flowers and fruits, without loss of flavour and odour; larger seeds, possessing greater germinative power; more complete assimilation of the plant-food in the soil, and freedom from vermin.

Prof. Holdefleiss ("Der Landwirth") has observed that beet seed, sown in a flower-pot so placed that the soil was exposed to the electric light, germinated two days earlier than similar seeds without the action of the electric light.

Herr Schöller, in the same journal, testifies to the exceptional luxuriance of beets, in a plot of about 2 square metres, which had been struck by lightning.

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